SELECTED WATER RESOURCES ABSTRACTS

VOLUME 2, NUMBER 13
JULY 1, 1969

W69-05201 -- W69-05600

UNIVERSITY OF KENTUCKY
WATER RESOURCES INSTITUTE
LEXINGTON, KENTUCKY

Selected Water Resources Abstracts is published semimonthly for the Water Resources Scientific Information Center (WRSIC) by the Clearinghouse for Federal Scientific and Technical Information (CFSTI) of the Bureau of Standards, U. S. Department of Commerce. It is available to Federal agencies, contractors, or grantees in water resources upon request to: Manager, Water Resources Scientific Information Center, Office of Water Resources Research, U. S. Department of the Interior, Washington, D. C. 20240. Annual subscription is $22.00 (domestic), $27.50 (foreign), single copy price is $3.00. Certain documents abstracted in this journal can be purchased from the Clearinghouse at the prices indicated in the entry. Prepayment is required.

CLEARINGHOUSE
FOR FEDERAL SCIENTIFIC AND TECHNICAL INFORMATION

U.S. Department of Commerce, Springfield, Va., 22151

180

SELECTED
WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior

VOLUME 2, NUMBER 13
JULY 1, 1969

W69-05201 -- W69-05600

Use of funds for printing this publication approved by the Director of the Bureau of the Budget, September 4, 1968.

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.
- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

CONTENTS

FOREWORD_____iii

SUBJECT FIELDS AND GROUPS

(Use Edge Index on back cover to Locate Subject Fields and Indexes in the journal.)

01 NATURE OF WATER
Includes the following Groups: Properties; Aqueous Solutions and Suspensions

02 WATER CYCLE
Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION
Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL
Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Non-Water Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION
Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING
Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA
Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS
Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES
Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION
Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

ABSTRACT SOURCES

SELECTED WATER RESOURCES ABSTRACTS

01. NATURE OF WATER

1B. Aqueous Solutions and Suspensions

HYDRODYNAMIC DISPERSION IN A SATURATED HOMOGENEOUS POROUS MEDIUM AT LOW PECLET NUMBERS AND NON-HOMOGENEOUS SOLUTION,
Guelph Univ. (Ontario).
Yehuda Bachmat.
Water Resources Res, Vol 5, No 1, pp 139-143, Feb 1969. 5 p, 7 ref.

Descriptors: *Dispersion, *Diffusion, *Porous media, Flow, Groundwater movement, Density, Circulation, Fluid mechanics, Mass transfer, Mixing.
Identifiers: Binary solutions, Density gradient.

The coefficient of mechanical dispersion of a solute in a homogeneous porous medium saturated by a binary diluted solution is derived, taking into account nonuniform density and viscosity fields. It is shown that in the neighborhood of a vanishing macroscopic velocity, a nonuniform density field induces a macroscopic dispersion resulting from the variation of microscopic density gradients and from horizontal variations of the macroscopic density. Both together yield the macroscopic effect of density instability on solute redistribution phenomena in porous materials. (Knapp-USGS)
W69-05434

02. WATER CYCLE

2A. General

AN EXPERIMENTAL INVESTIGATION OF PARTIAL AREA CONTRIBUTIONS,
Maryland Univ., College Park.
Robert M. Ragan.
Int Ass Sci Hydrol Pub No 76, Symp on Hydrol Aspects of Util of Water, Bern, Sept 25-Oct 7, 1967, pp 241-251, 1968. 11 p, 5 fig, 8 ref.

Descriptors: *Routing, *Runoff, *Rainfall-runoff relationships, Subsurface runoff, Flood routing, Surface-groundwater relationships, Hydrographs, Discharge (Water), Infiltration, Rainfall intensity, Storm runoff, Interception, Vermont.
Identifiers: Partial area runoff contribution.

The paper describes a detailed experimental-numerical investigation of the concept of partial area contributions to storm hydrographs. A computer solution of a numerical flood routing technique was used to isolate the time-spatial distribution of local runoff entering the main channel of a small watershed. Extensive experimental information collected in the vicinity of the 619 ft length of second order stream provided a means of interpreting these land-phase hydrographs. Analysis of a series of storms showed that only a small portion of the watershed ever contributed flow to the storm hydrograph. The contributing area was found to be a function of the storm duration and intensity and, rather than being uniformly distributed along the length of the channel, it existed in the form of localized zones of intense contribution. In a given storm the contributng area was found to fluctuate with changes in the rainfall intensity. During periods of low intensity, most of the flow came from channel precipitation and rain falling on the wet areas surrounding a series of seeps. If a period of high intensity occurred, flow developed through the forest litter on the hillsides and thereby created a larger contributing area. No interflow in the soil mass above the water table was encountered. A rapid response of the groundwater at some points along the channel, however might have been interpreted as interflow if extensive measurements had not been taken. The behavior of the watershed was quite logical when the fundamentals of the individual processes were considered. The results of the study illustrate that there is a need for a re-evaluation of some of the traditional methods used for runoff computations. Furthur, any parametric model developed for the synthesis of hydrologic events should be able to reflect partial area contributions. (Knapp-USGS)
W69-05227

STUDIES OF RUNOFF FORMATION UNDER CONDITION OF HIGH-ANGLE ATTITUDE OF THE IMPERVIOUS BED,
Hydrometeorological Centre (USSR).
For primary bibliographic entry see Field 02E.
W69-05229

MOUNTAIN RIVER FLOOD RUNOFF THEORY, MEANS OF ITS INVESTIGATION AND CALCULATION,
Gidrometeorologicheskii Institut, Odessa (USSR).
A. N. Befani.
Int Ass Sci Hydrol Pub No 76, Symp on Hydrol Aspects of Util of Water, Bern, Sept 25-Oct 7, 1967, pp 323-333, 1968. 11 p, 6 ref.

Descriptors: *Rainfall-runoff relationships, *Flood routing, *Mountains, *Slopes, Topography, Infiltration, Subsurface runoff, Hydrographs, Hydrograph analysis, Rainfall intensity, Rainfall disposition.
Identifiers: USSR.

Results of extensive experimental studies of mountain slope runoff formation carried out by a number of institutes in the USSR are treated and a theory of mountain runoff and a verification of regional design methods are presented. A great variety of mountain runoff genetic types, the basic being the surface and contact ones, are indicated. The latter takes place in friable surface sediments on an underlying relative confining layer, a slightly fissured rock or loam-skeleton layer. The theories of contact and surface runoff are developed on the basis of integration of partial differential runoff equations using subsequent approximation methods to solve complex mathematical formulae. As a result simple theoretical expressions determining a slope flood runoff component, a maximum runoff module, and a surface and contact flow discharge hydrograph equation are obtained. Parameters of different types of slope flow time and parameters of losses including surface infiltration, infiltration into the underlying rock, and soil storage are the main components of theoretical equations. Performance investigations made it possible to verify the regional formula calculation method for layer and slope inflow discharge hydrograph computation. (Knapp-USGS)
W69-05230

NUMERICAL FORECASTING OF MOUNTAIN RIVER FLOOD RUNOFF ON THE BASIS OF ESTABLISHING TERRITORIALLY - GENERALIZED RELATIONSHIPS,
Gidrometeorologicheskii Institut, Odessa (USSR).
N. F. Benfani.
Int Ass Sci Hydrol Pub No 76, Symp on Hydrol Aspects of Util of Water, Bern, Sept 25-Oct 7, 1967, pp 334-342, 1968. 9 p, 1 fig, 2 ref.

Descriptors: *Rainfall-runoff relationships, *Routing, *Mountains, *Slopes, Topography, Infiltration, Subsurface runoff, Hydrograph analysis, Rainfall intensity, Rainfall disposition.
Identifiers: Carpathian Mountains (USSR), Sikhote-Alin Mountains (USSR), Flood runoff.

Results of analysis and generalization of experimental data and observations of mountain rivers of the Carpathian and Sikhote-Alin mountain slopes are reported. The work is based on a genetic theory of mountain slope runoff. A theoretical balance formula including surface and contact components of a total runoff layer is presented. Components of a theoretical equation are determined for experimental plots and natural drainage basins. Storage in a friable sediment layer is expressed as a function of an antecedent moistening index and runoff-forming rainfall. Infiltration losses are presented as a function of time and antecedent moistening index. In this case infiltration contact runoff losses are estimated in terms of inter-rain intervals and duration of fall. A surface flood runoff component as a function of friable rock saturation and other factors is also introduced. Generalization of local relationships enabled the establishment of parameters of losses for territories of homogeneous structures and soils. Specific examples show that the utilization of theoretical and experimental parameters give territorially-generalized relationships, approaching the forecast of the runoff of small ungaged rivers.
W69-05231

THE ASSESSMENT OF SURFACE RUNOFF FROM RAINFALL DATA FOR AN ARID REGION OF WEST PAKISTAN,
MacDonald (Murdoch) and Partners, London (England).
For primary bibliographic entry see Field 02E.
W69-05232

THE ASSESSMENT OF RUNOFF FROM A MOUNTAINOUS AND SEMI-ARID AREA IN WESTERN IRAN,
Hydrological Research Unit, Wallingford (England); Gibb (Alexander) and Partners, London (England).
For primary bibliographic entry see Field 02E.
W69-05233

DESIGN CRITERIA FOR LABORATORY CATCHMENT EXPERIMENTS, WITH PARTICULAR REFERENCE TO RAINFALL SIMULATION,
Imperial Coll. of Science and Technology, London (England).
M. J. Hall, and P. O. Wolf.
Int Ass Sci Hydrol Pub No 76, Symp on Hydrol Aspects of Util of Water, Bern, Sept 25-Oct 7, 1967, pp 395-406, 1968. 12 p, 1 tab, 19 ref.

Descriptors: *Rainfall-runoff relationships, *Laboratory tests, *Model studies, *Hydraulic models, *Rainfall simulators, Runoff, Rainfall intensity, Erosion, Streamflow forecasting.
Identifiers: *Laboratory catchment experiments.

Study of the hydrological cycle of an artificial catchment area under laboratory conditions is reviewed and discussed. If 'laboratory catchment' is defined as a physical system of limited areal extent on to which on 'input' of rainfall, either real or simulated, is applied to produce in 'output' in the form of surface and/or subsurface runoff, it is seen that the concept is not recent. The pioneer work on soil erosion problems in the United States during the 1930's was largely based upon the study under controlled conditions of small plots, each of which was effectively a simplified model of the hydrological cycle. In studies of the hydraulics of overland flow during the 1940's, an even simpler conceptual model was investigated. The first attempt to construct a scale model of a natural catchment was made during the 1950's, and in the 1960's there is a return to the use of the plane, two-dimensional impervious surface, not as a small hydraulic prototype, but as a 'system' for generating data against which non-linear rainfall/runoff theories can be tested. Existing work is reviewed and a new approach to the problem of determining the influence of catchment characteristics on the shape of flood hydrographs using artificial catchment areas in the laboratory is suggested. A major difficulty in any laboratory catchment experiment is the design of the associated equipment for the production of storms of artificial rainfall. The selection of design criteria for the rainfall simulator to be used in the proposed experiments is discussed in detail, and a working solution outlined. (Knapp-USGS)
W69-05234

PREPARATION OF CO-ORDINATED PRECIPITATION, RUNOFF AND EVAPORATION MAPS,
World Meteorological Organization, Geneva (Switzerland).
Tor J. Nordenson.
Report No. 6 of Reports on WMO/IHD Projects, 1968. 20 p, 3 tab, 13 fig, 32 ref.

Descriptors: *Precipitation, *Evaporation, Water balance, *Runoff, Design data.
Identifiers: Water control structures.

In the design of water control structures for water supply, hydro-electric power, irrigation, navigation and flood control, it is necessary to have knowledge of the volume of water available. Estimates of actual evapotranspiration loss are required for determining irrigation needs and increased losses from construction of reservoirs in arid and semi-arid areas. This report attempts to describe methods for the preparation of maps of average annual precipitation, runoff and evaporation. Major emphasis is devoted to the co-ordinated development of these maps in order to attain a consistency between them which will provide a nearly true water balance.
W69-05337

IN DEFENSE OF EXPERIMENTAL WATERSHEDS,
Georgia Univ., Athens. School of Forestry; and Northeastern Forest Experiment Station, Upper Darby, Pa.
John D. Hewlett, Howard W. Lull, and Kenneth G. Reinhart.
Water Resources Res, Vol 5, No 1, pp 306-316, Feb 1969. 11 p, 1 tab, 40 ref.

Descriptors: *Demonstration watersheds, Model studies, Watersheds (Basins), Synthetic hydrology, Stream gages, Hydrologic budget.
Identifiers: Experimental watersheds.

Recent criticisms discount the contribution of experimental watersheds to the science of hydrology and to watershed management. The critics cite as disadvantages the cost of experimental watersheds, their unrepresentativeness, leakiness, difficulty in applying results to other areas, and the lack of progress in basic knowledge about hydrologic processes. Some critics propose mathematical synthesis, statistical analysis, plot studies, soil moisture studies, meteorological methods, and the study of individual hydrologic processes as alternatives to experimental watersheds. The criticisms lack weight, because published results of catchment experiments were not carefully reviewed. The alternatives are obviously aids rather than substitutes for experiments on watersheds. By reference to recent and older results, the authors argue that the experimental watershed method has produced much of our present knowledge about the land phase of the hydrologic cycle and man's influence on it, that method is sound, and that its future in any comprehensive research program is secure. (Knapp-USGS)
W69-05405

TREATED WATERSHED YIELDS IMPROVED WATER HARVEST,
Geological Survey, Albuquerque, N. Mex.
For primary bibliographic entry see Field 03B.
W69-05410

HYDROLOGIC EFFECTS OF THE 1962-66 DROUGHT ON LONG ISLAND, N. Y.,
Geological Survey, Washington, D. C.
Philip Cohen, O. L. Franke, and N. E. McClymonds.
Geol Surv Water-Supply Pap 1879-F, pp F1-F18, 1969. 18 p, 10 fig, 7 ref.

Descriptors: *Droughts, *Hydrologic aspects, *Water level fluctuations, Groundwater, Streamflow, Precipitation (Atmospheric), Runoff, Water storage, Discharge (Water), Crop response, Soil moisture.
Identifiers: Long Island (N.Y.).

The hydrologic system of Long Island, N. Y., showed a marked response to deficient precipitation in the years 1962-66. By 1966, streamflow was the lowest of record in many Long Island streams, and groundwater levels had declined a maximum of about 10 feet in the central part of the island. Although the drought apparently ended in the early months of 1967 and groundwater levels and streamflow recovered somewhat since then, groundwater levels and streamflow were still considerably below long-term average values in September 1968. (Knapp-USGS)
W69-05411

RAINFALL-RUNOFF MODEL FOR SMALL BASIN FLOOD HYDROGRAPH SIMULATION,
Geological Survey, Menlo Park, Calif.
R. W. Lichty, D. R. Dawdy, and J. M. Bergmann.
Int Ass Sci Hydrol Pub No 81, Symp of Tucson-1968, pp 356-367, 1968. 12 p, 6 fig, 2 tab, 10 ref.

Descriptors: *Mathematical models, *Computer models, *Rainfall-runoff relationships, Optimization, Streamflow forecasting, Runoff forecasting, Simulation analysis, Floods, Flood forecasting, Antecedent precipitation, Precipitation excess.
Identifiers: Peak stages, Philips equation.

A simplified, mathematical model of the surface-runoff component of streamflow response to storm rainfall was developed and programmed for digital-computer solution. The model uses an infiltration component based on an equation by Philip to determine rainfall excess, which is transformed by a linear basin-response function to simulate the flood hydrograph. An objective-fitting procedure that emphasizes the simulation of peak-discharge rate was used to identify optimum model parameters in a pilot study of a 5-sq mi drainage basin in North Carolina. Split-sample fitting and testing showed that predictive capability varied for 3 samples of flood events. Results of simulation for 2 test samples of pre-1948 flood events showed reasonable correspondence between simulated and observed flood peaks. The post-1948 test sample showed wide scatter between simulated and observed flood peaks. Sensitivity analysis of objective-function response to parameter incrementation showed that antecedent moisture accounting grossly controlled the results of optimization. (Knapp-USGS)
W69-05420

A PROPOSED MECHANICS FOR THE INVESTIGATION OF SURFACE RUNOFF FROM SMALL WATERSHEDS. 1, DEVELOPMENT,
Ohio Agricultural Research and Development Center, Wooster.
George E. Merva, Ross D. Brazee, Glenn O. Schwab, and R. Bruce Curry.
Water Resources Res, Vol 5, No 1, pp 76-83, Feb 1969. 8 p, 2 fig, 6 ref. Grant ITI-WP-39-01A1-PHS. OWRR Project B-005-OHIO.

Descriptors: *Rainfall-runoff relationships, *Small watersheds, *Stochastic processes, Statistical models, Markov processes, Probability, Equations, Isotropy.
Identifiers: Brownian motion analogy.

A probabilistic method is proposed for predicting runoff from small watersheds. An analogy with Brownian motion is used to find the relationship between a stochastically impressed force acting upon fluid particles on a planar surface with a statistically homogeneous and isotropic distribution of random roughness. Fluid motion is studied as a function of energy degradation for a particle collection in random motion induced by surface forces. (Knapp-USGS)
W69-05425

RUNOFF VOLUME PREDICTION FROM DAILY CLIMATIC DATA,
Agricultural Research Service, Riesel, Tex.; and Agricultural Research Service, Chickasha, Okla.
Walter G. Knisel, Jr., Ralph W. Baird, and Monroe A. Hartman.
Water Resources Res, Vol 5, No 2, pp 84-94, Feb 1969. 11 p, 8 fig, 9 ref.

Descriptors: *Rainfall-runoff relationships, *Soil moisture, *Runoff forecasting, Model studies, Mathematical models, Digital computers, Hydrologic budget, Discharge (Water), Infiltration, Inflow, Streamflow, Water balance, Evaporation, Precipitation intensity, Duration curves, Hydrograph analysis, Hydrographs.
Identifiers: Soil moisture reservoir, Runoff prediction.

A two-soil-moisture-reservoir model is developed to improve the estimate accuracy of a runoff-volume-prediction model. Soil moisture accounting in the two reservoirs is an intermediate step to runoff prediction. A decay-type function describes the moisture depletion between days of rainfall. The moisture depletion constant in the function varies by season with soil moisture, pan evaporation, and mean daily temperature. The runoff-prediction equation relates runoff to rainfall and soil moisture at the beginning of the storm. Computed runoff volumes are compared with values observed on a 3-acre native grass-meadow watershed for an 11-year period. Accumulated computed amounts for the period agree within 1% of the accumulated observed amounts. (Knapp-USGS)
W69-05426

USING ANALYTICAL METHODS TO DEVELOP A SURFACE-RUNOFF MODEL,
Tennessee Valley Authority, Knoxville.
Roger P. Betson, Russell L. Tucker, and Faye M. Haller.
Water Resources Res, Vol 5, No 1, pp 103-111, Feb 1969. 9 p, 5 fig, 2 tab, 5 ref.

Descriptors: *Rainfall-runoff relationships, *Runoff forecasting, *Analytical techniques, Rainfall intensity, Antecedent precipitation, Meteorology, Mathematical models, Computer models, Digital computers.
Identifiers: Graphical methods, Analytical models.

By using analytical methods, successive restrictions were imposed on a mathematical version of the U. S. Weather Bureau's graphical surface-runoff model to develop an analytical model that expresses the API (Antecedent precipitation index)-runoff relations with 2 equations and 5 coefficients. The analytical model is similar in concept to the graphical model in that both relate rainfall, week number, and the API measure to surface runoff. The concise relations of the analytical model, however, can be rapidly derived from a historical storm list by computer. When tested, runoff relations derived with the analytical model over selected watersheds, predicted surface runoff from those watersheds somewhat better than the regional graphical relations developed for the Valley. (Knapp-USGS)
W69-05431

SYNTHETIC HYDROGRAPHS; EFFECTS OF NETWORK GEOMETRY,
Thomas J. Watson Research Center, Yorktown Heights, N. Y.
A. J. Surkan.
Water Resources Res, Vol 5, No 1, pp 112-128, Feb 1969. 17 p, 20 fig, 8 ref.

Descriptors: *Synthetic hydrology, *Hydrographs, Routing, Mathematical models, Computer models, Digital computers, Simulation analysis, River systems, Stochastic processes, Streamflow, Rainfall disposition, Storage.
Identifiers: *Synthetic hydrographs, Algorithmic methods, Synthetic drainage basins.

mathematical model for channel networks epresented by directed graphs on a rectangular id is used to generate synthetic hydrographs. This akes possible simulation of the effects of changes geometric factors specified by shape and con-ectivity, while keeping fixed a prescribed tem-oral and spatial precipitation pattern. Alternative-, this model may be used with fixed networks of terest to study effects of different types and mo-ons of storms. The model provides for a discrete pproximation of a distributed network, a transfor-ation relating the runoff hydrograph and input ecipitation. No combinations of generating arameters had to be determined, since only a sin-e parameter associated with the collection and lease of water to the channel was used. Although is parameter, which was the collection area orage constant, and the speed of travel for ecipitation could be given different values at ch point on the network, and might be varied as a nction of time, both were assumed to be fixed in ne and spatially uniform. The formation of drographs is determined by interlocking relation-ips between the network's geometry, its storage nctions, and temporal and spatial variations of ecipitation reaching and traversing a graphically ecified network. (Knapp-USGS)
69-05432

UNOFF HYDROGRAPH AS A FUNCTION OF AINFALL EXCESS,
ambridge Univ. (England).
K. Hill.
ater Resources Res, Vol 5, No 1, pp 95-102, Feb 969. 8 p, 5 fig, 6 ref.

escriptors: *Rainfall-runoff relationships, Mathematical models, *Runoff forecasting, Streamflow forecasting, *Hydrographs, Duration rves, Rainfall intensity, Hyetographs, Precipita-n excess, Surface runoff, Overland flow, Storm noff.
entifiers: Kinematic wave theory.

set of differential equations has been obtained r the overland runoff from an arbitrary tchment when the rainfall excess over the tchment is known as a function of space and ne. An analytical solution is given for a steady in of finite duration. The differential equations btained are also solved analytically for a moving p-hat storm over a plane catchment, and the aximum depth is obtained explicitly as a function the storm duration and catchment length. The sults for all plane catchments with a given re-stance formula are reduced to a single curve. It is und that the depth is increased if the storm moves wnstream and decreased if the storm moves up-eam the slower the storm the greater being the ange. Finally, it is shown that all the results apply alitatively to open channel flow where the kine-atic wave approach is suitable. If the lateral in-w replaces the rainfall excess, it is found that the rm of the curve describing the variation of depth th time is a function of the cross-section ometry but is qualitatively similar to the overland w curve described above. (Knapp-USGS)
69-05438

ECURRENCE INTERVALS BETWEEN EX-EEDANCES OF SELECTED RIVER LEVELS. ALTERNATIVES TO A MARKOV MODEL,
ew South Wales Univ. Kensington (Australia); d Commonwealth Scientific and Industrial esearch Organization, Canberra (Australia). Div. Land Research.
r primary bibliographic entry see Field 02E.
69-05454

B. Precipitation

YDROMETEOROLOGICAL STUDIES IN SUP-ORT OF THE INTERNATIONAL FIELD YEAR OR THE GREAT LAKES,
eteorological Service of Canada, Toronto (On-rio). Hydrometeorology Section.
L. Richards.

Int Ass Sci Hydrol Pub No 76, Symp on Hydrol Aspects of Util of Water, Bern, Sept 25-Oct 7, 1967, pp 171-180, 1968. 10 p, 21 ref.

Descriptors: *Great Lakes, *International Hydrological Decade, International Joint Commission, Conferences, Data collections, Networks, Hydrology, Meteorology, Synoptic analysis, Governments, Water resources development, International commissions.
Identifiers: Canada, Hydrometeorological studies.

The Canadian and United States Com for the Int Hydrol Decade agreed to sponsor an International Field Year on the Great Lakes. Concentrated scientific studies are planned for Lake Ontario for an 18-mo period beginning Apr 1, 1970. First, there will be feasibility studies, project planning, and instrument development. Preliminary proposals have been designed to evaluate atmospheric and terrestrial water budgets and the energy balance of a lake as well as the circulation, wave climatology and diffusion characteristics. The program will be based on a limited number of primary projects to be sponsored by agencies in Canada and the United States responsible for major observational programs. Universities, research institutes and individual scientists from all countries will be welcome to conduct studies and investigations in support of, or auxiliary to, the primary projects, and data from the major observing programs will be made available to assist such studies. Many studies will be of a hydrometeorological nature, including an investigation of lake level variations as related to precipitation, evaporation and the inflow and outflow of surface and groundwater. Evaporation will be assessed by all means including atmospheric water budget, energy balance, water budget, mass transfer and micrometeorological flux techniques. The difference between over-lake and overland precipitation amounts will also receive special attention through improved rain gauge networks and weather radar film analyses by an optical scanning device. (Knapp-USGS)
W69-05222

SNOW ACCUMULATION AS RELATED TO METEOROLOGICAL, TOPOGRAPHIC, AND FOREST VARIABLES IN CENTRAL SIERRA NEVADA, CALIFORNIA,
Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.
For primary bibliographic entry see Field 02C.
W69-05226

THE WEATHER BUREAU AND WATER MANAGEMENT.
Weather Bureau, Silver Spring, Md.
For primary bibliographic entry see Field 07C.
W69-05336

AN ACCURATE SMALL ORIFICE RAIN GAGE,
Volcani Inst. of Agricultural Research, Bet Dagan (Israel); and Israel Meteorological Service, Bet Dagan.
For primary bibliographic entry see Field 07B.
W69-05404

HYDROLOGIC EFFECTS OF THE 1962-66 DROUGHT ON LONG ISLAND, N. Y.,
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 02A.
W69-05411

2C. Snow, Ice, and Frost

SNOW ACCUMULATION AS RELATED TO METEOROLOGICAL, TOPOGRAPHIC, AND FOREST VARIABLES IN CENTRAL SIERRA NEVADA, CALIFORNIA,
Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.
Henry W. Anderson.
Int Ass Sci Hydrol Pub No 76, Symp on Hydrol Aspects of Util of Water, Bern, Sept 25-Oct 7, 1967, pp 215-224, 1968. 10 p, 4 tab, 22 ref.

Descriptors: *Snowfall, *Snow cover, *Energy budget, *Topography, Melting, Radiation, Winds, Trees, Forests, Terrain analysis, Regression analysis, Microenvironment, California.
Identifiers: Multivariate analysis, Terrain, Snow accumulation, Sierra Nevada.

Snow accumulation at individual points in forest and openings in forests was studied by selecting 16 periods in the winter of 1957-58 under different meteorological conditions. Wide differences in topography and forest conditions were obtained by selection of 250 points from 1,300 available. Snow accumulation was the difference in water equivalent of the snow pack between measurements. Meteorological variables included functions of clouds, wind, humidity, temperature, and precipitation. Forest variables included indexes of shade, back radiation, interception, cold air drainage, and shelter from the wind. Topography was expressed in terms of solar energy received and exposure to prevailing winds. The factors related to snow accumulations were studied by reduced rank procedure of principal components, principal axis, canonical, and alpha factoring with varimax rotation of the factors. The best regressions relating the variables to snow accumulations arose from principal components analysis when highly correlated variables were included. Snow accumulation depended strongly on combinations of meteorological and forest variables, and on forest-meteorological interactions. Interception of snow, as indexed by the canopy over the point, averaged 10% of the precipitation. Snow accumulation in forest openings, forest margins, and in large areas of uniform forest had different relations to meteorological and topographic variables. Forest shade and back radiation from trees were most important on high energy south slopes. (Knapp-USGS)
W69-05226

PATTERNS OF BACKWATER AND DISCHARGE ON SMALL ICE-AFFECTED STREAMS,
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 07B.
W69-05256

2D. Evaporation and Transpiration

EVAPORATION FROM BOGS IN THE EUROPEAN TERRITORY OF THE USSR,
State Hydrological Inst., Leningrad (USSR).
V. V. Romanov.
Trans. of mono. Isparenie s Bolot Evropeiskoi Territorii SSR, 1962, 227 p. Available from CFSTI as TT-67-51293 HC$3.00 MF$0.65. Dep Agr and Nat Sci Found Rep, 1968. 183 p, 52 fig, 39 tab, 87 ref, 2 append.

Descriptors: *Bogs, *Evaporation, Evapotranspiration, Heat budget, Hydrologic budget, Temperature, Precipitation (Atmospheric), Runoff, Discharge (Water), Groundwater, Soil water, Drainage, Infiltration, Streamflow.
Identifiers: USSR, Bog evaporation studies.

Bogs occupy a little less than 10% of the USSR. Bog evaporation is 10.8% of the total evaporation below latitude 60 deg N and 17.3% of the total north of 60 deg. Total European USSR bog evaporation is about 94 cu km per yr. Bog evaporation is studied by heat and water budget methods in a nationwide program of large-scale bog reclamation and peat production. The budget methods used are described in detail. Results of calculations are presented and discussed for undrained highmoor bogs, undrained lowmoor bogs, and drained bogs. (Knapp-USGS)
W69-05214

A METHOD OF DETERMINING EVAPOTRANSPIRATION IN SOIL MONOLITHS,
Institute for Land and Water Management Research, Wageningen (Netherlands).
W. C. Visser.

UNESCO Arid Zone Research, Vol 25, pp 453-460, 1965. 9 fig, disc, 7 ref.

Descriptors: *Soil moisture, *Evapotranspiration, *Transmissivity, *Model studies, *Soil profiles, Evaporation, Permeability, Root systems, Aeration, Moisture content, Instrumentation, Measurement, Data collections, Density, Depth, Sampling, Equations, Hydrologic properties, Flow.
Identifiers: *Monoliths, Desorption.

A model of the evaporation process with respect to the influence of soil is developed. Described here is the installation constructed to measure the required data. The model shows that influences will be exerted on evapotranspiration by transmissibility of the plant, permeability of the soil, the desorption curve and root density. Since the determinations nearly all require taking samples, one has to work with a container of such dimensions that soil in the monolith is not damaged too much by sampling. The formula developed does not account for variations in root density and suction pressure with depth, nor is impeded aeration considered. The formula may be valuable as a starting point for further improvements of the description of the processes of evaporation and depletion of soil moisture. (Blecker-Ariz)
W69-05270

THE INTERCEPTION-TRANSPIRATION RELATIONSHIP OF WHITE SPRUCE AND WHITE PINE,
Minnesota Univ., St. Paul, School of Forestry; Arizona Univ., Tucson, Dept. of Watershed Management.
J. A. Nicolson, D. B. Thorud, and E. I. Sucoff.
J Soil and Water Conservation, Vol 23, No 5, pp 181-184, Sept-Oct 1968. 1 fig, 3 tab, 10 ref.

Descriptors: *Interception, *Transpiration, *Soil moisture, *White pine trees, *Coniferous trees, Evaporation, Humidity, Radiation, Moisture stress, Calibrations, Diurnal, Water balance, Wetting, Wind velocity, Bouyoucos blocks, Water conservation.
Identifiers: *White spruce trees.

A study was conducted on the interception-transpiration relationship of two widely distributed northern conifers--white spruce and eastern white pine. Intercepted water reduced transpiration and conserved soil moisture. Mean saving in relation to the amount of intercepted water applied was 13% for white spruce and 12% for white pine. Grouping periods according to the number of wettings required during a 3 1/2 hour period showed that the percentage of water saved in white pine decreased as the number of wettings increased. White spruce failed to show any trend. Percentage of water saved in white spruce tended to decrease as wind speed increased. Water savings in white pine appeared to be greatest during calm, humid and low radiation periods. Savings in white spruce tended to be higher in environments favoring moderate transpiration. Principles and procedures outlined in the study could possibly be used to determine ways of reducing transpiration and conserving soil moisture in arid climates. (Blecker-Ariz)
W69-05274

2E. Streamflow and Runoff

FLOOD PLAIN INFORMATION, SOUTHWEST BRANCH, PRINCE GEORGES COUNTY, MARYLAND.
Corps of Engineers, Baltimore, Md.
For primary bibliographic entry see Field 04A.
W69-05203

FLOOD PLAIN INFORMATION (ANACOSTIA RIVER), PRINCE GEORGES COUNTY, MARYLAND.
Corps of Engineers, Baltimore, Md.
For primary bibliographic entry see Field 04A.
W69-05204

FLOOD PLAIN INFORMATION, INTRENCHMENT, SUGAR, DOOLITTLE AND DOLESS CREEKS.
Corps of Engineers, Savannah, Ga.
For primary bibliographic entry see Field 04A.
W69-05205

FLOOD PLAIN INFORMATION OF PROCTOR CREEK, METROPOLITAN ATLANTA, GEORGIA.
Corps of Engineers, Mobile, Ala.
For primary bibliographic entry see Field 04A.
W69-05206

FLOOD PLAIN INFORMATION ON HEADWATERS SOUTH RIVER, METROPOLITAN ATLANTA, GEORGIA.
Corps of Engineers, Savannah, Ga.
For primary bibliographic entry see Field 04A.
W69-05207

COMPARATIVE STUDY OF SNOW TYPE HYDROLOGY OF NORTHEASTERN CANADA AND OF PLAINS OF RUSSIA AND SIBERIA,
Catholic Univ. of America, Washington, D. C.
Boris S. Browzin.
Int Ass Sci Hydrol Pub No 76, Symp on Hydrol Aspects of Util of Water, Bern, Sept 25-Oct 7, 1967, pp 204-214, 1968. 11 p, 5 fig, 2 tab, 9 ref, 1 append.

Descriptors: *Hydrographs, *Hydrograph analysis, *Climatology, *Synoptic analysis, *Cold regions, Subarctic, Meteorology, Climatic zones, Snow, Weather, Runoff, Streamflow.
Identifiers: North America, Siberia, Climatic-hydrologic relations.

River hydrology is defined by a dimensionless monthly hydrograph of twelve coefficients, which are ratios of the mean monthly flow to the mean annual flow. The hydrograph is a function of climatic factors determined by climatic indices. The type of precipitation and the temperatures are factors determining the hydrologic character. The study of snow hydrology of northeastern Canada and that of European Russia and Siberia indicates that in similar climatic conditions the hydrology is similar. However, because of differences in climate the snow hydrology is considerably different in deeply continental locations of Eurasia as compared with northeastern Canada. Eastern Canada is wetter than European Russia and much more than Siberia, but European Russian and Siberian climate is generally cooler than that of eastern Canada. The magnitude of climatic indices determined for those countries made it possible to explain causes of the different character of snow hydrology in the studied parts of Northern America, Europe and Asia. (Knapp-USGS)
W69-05225

AN EXPERIMENTAL INVESTIGATION OF PARTIAL AREA CONTRIBUTIONS,
Maryland Univ., College Park.
For primary bibliographic entry see Field 02A.
W69-05227

TIME-OF-TRAVEL MEASUREMENTS AND OTHER APPLICATIONS OF DYE TRACING,
Geological Survey, Cheyenne, Wyo. Water Resources Division.
For primary bibliographic entry see Field 07B.
W69-05228

STUDIES OF RUNOFF FORMATION UNDER CONDITION OF HIGH-ANGLE ATTITUDE OF THE IMPERVIOUS BED,
Hydrometeorological Centre (USSR).
A. G. Levin, and A. S. Kouznetzov.
Int Ass Sci Hydrol Pub No 76, Symp on Hydrol Aspects of Util of Water, Bern, Sept 25-Oct 7, 1967, pp 300-305, 1968. 6 p, 4 fig, 4 ref.

Descriptors: *Rainfall-runoff relationships, *Permafrost, *Floods, Frozen ground, Flash floods, Cold regions, Evaporation, Runoff, Infiltration, Melting, Hydrograph analysis, Precipitation (Atmospheric), Rainfall intensity.
Identifiers: USSR, Kolyma River (USSR).

During the summer and the fall, rain floods are most characteristic of the water conditions of mountaineous streams in the areas where ground is frozen. Sometimes the floods are quite dangerous and exceed considerably the spring flood. If we take the mountain Upper Kolyma basin, for example, in the area of perennial frozen ground, and consider the conditions of flood formation there, we may come to the following conclusions: the floods are formed on account of the precipitation flowing on the surface and mainly within the layer of seasonal melting. The underlying ground is not in fact involved in the water circulation process and serves only as a water-resisting bed. The flood depends on the amount of the precipitation, on its distribution on the basin conditions. The inflow due to snow melting in the mountains and ice body thawing has no important effect on the flood formation accounting for about 5 to 10% of the summer period drainage. Some calculations are given as an example, showing that during rains evaporation water losses make 20% and more of the total. The losses on surface drainage and in the active layer depend on the nature of the underlying surface and the depth of melting of the active frozen ground layer. (Knapp-USGS)
W69-05229

MOUNTAIN RIVER FLOOD RUNOFF THEORY, MEANS OF ITS INVESTIGATION AND CALCULATION,
Gidrometeorologicheskii Institut, Odessa (USSR).
For primary bibliographic entry see Field 02A.
W69-05230

THE ASSESSMENT OF SURFACE RUNOFF FROM RAINFALL DATA FOR AN ARID REGION OF WEST PAKISTAN,
MacDonald (Murdoch) and Partners, London (England).
J. H. Fleming.
Int Ass Sci Hydrol Pub No 76, Synp on Hydrol Aspects of Util of Water, Bern, Sept 25-Oct 7, 1967, pp 369-382, 1968. 14 p, 3 fig, 4 tab, 1 ref, append.

Descriptors: *Rainfall-runoff relationships, *Arid lands, *Streamflow forecasting, *Flood forecasting, *Routing, Water resources, Rainfall intensity, Rainfall disposition, Infiltration, Runoff, Subsurface runoff, Stream gages.
Identifiers: Pakistan, Kachhi Plain (Pakistan).

In assessing the water resources of the Kachhi Plain in West Pakistan the annual flood runoff from 15,000 sq mi of arid mountainous catchment had to be estimated. There were no reliable flood discharge measurements for any extended period of time on any of the rivers, but the rainfall records were good, and extended back in some cases for 70 yr. Average annual rainfall varied between 4 and 14 in. The problem was to make an initial assessment of 50 yr of surface runoff after 18 mo correlation of measured discharges and rainfall, and to refine the approximation as data accumulated. It was assumed that the runoff coefficient was dependent on the quantity of rain, the intensity of rainfall, ground configuration, and rate of infiltration. The intensity of rainfall in the monsoon is much higher than in winter, so that the 2 seasons were considered separately. Ground configuration was assessed from air photographs. For each of 4 topographically defined sub-areas, further subdivided into 7.5 min quadrangles, the areas in each catchment and land class were known, and the seasonal rainfall was assigned by interpolation from isohyets. Runoff coefficients were evolved from measured rainfall and runoff over 4 gaged catchments for 2 monsoon seasons. Basically a runoff coefficient of 0.25 was found to apply for steep

rocky catchments and more than 3 in. of monsoonal rainfall. Correlation of the rainfall and runoff for the non-monsoon period was less satisfactory, because the runoff coefficients was much lower. Actual overall runoff coefficients for a 3-yr period varied between 0.232 and 0.039 for different catchments, but it was possible to reconcile these widely divergent figures in a reasonably satisfactory way. (Knapp-USGS)
W69-05232

THE ASSESSMENT OF RUNOFF FROM A MOUNTAINOUS AND SEMI-ARID AREA IN WESTERN IRAN,
Hydrological Research Unit, Wallingford (England); Gibb (Alexander) and Partners, London (England).
J. V. Sutcliffe, and T. G. Carpenter.
Int Ass Sci Hydrol Pub No 76, Symp on Hydrol Aspects of Util of Water, Bern, Sept 25-Oct 7, 1967, pp 383-394, 1968. 12 p, 4 fig, 3 tab, 8 ref.

Descriptors: *Rainfall-runoff relationships, *Mountains, *Routing, Slopes, Topography, Evaporation, Infiltration, Estimating, Synoptic analysis.
Identifiers: Iran, Rainfall-altitude relations, Karkheh River (Iran).

The assessment of river flows over an area requires a wider investigation of the hydrology than the study of measured flows at single sites; such studies of mountainous and semi-arid areas present problems which do not arise in flatter humid areas. An investigation of the surface water resources of a river basin in a mountainous regions of Iran is used to illustrate the problems involved. Because of the topography the precipitation is extremely variable, but the use of a rainfall-elevation relationship enables the residual effect of position to be deduced. For many hydrological purposes for such terrain it is preferable to map equivalent precipitation at a constant altitude rather than produce a complex isohyetal map. The effect of altitude on potential and actual evaporation is discussed and a relationship between rainfall and runoff is derived from the records. (Knapp-USGS)
W69-05233

NOMOGRAPHS FOR DETERMINING AMOUNT OF RHODAMINE B DYE FOR TIME-OF-TRAVEL STUDIES,
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 07B.
W69-05236

CONSTANT-RATE-INJECTION EQUIPMENT FOR DYE-DILUTION DISCHARGE MEASUREMENTS,
U S Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 07B.
W69-05237

SELECTION OF DYE-INJECTION AND MEASURING SITES FOR TIME-OF-TRAVEL STUDIES,
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 07B.
W69-05238

COMPARISON OF RESULTS USING THREE SAMPLING TECHNIQUES FOR A FLUOMETRIC DYE STUDY IN A STREAM,
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 07B.
W69-05239

COMPARISON OF FLOOD-WAVE AND WATER-PARTICLE TRAVELTIMES,
Geological Survey, Washington, D. C.
Thomas J. Buchanan.
Geol Surv Water-Supply Pap 1892, Selec Tech in Water Resources Invest, 1966-67, pp 34-36, 1968. 3 p, 1 tab, 1 ref.

Descriptors: *Floods, *Unsteady flow, *Flood forecasting, Flood routing, Tracers, Dye releases, Hydrographs, Channel morphology, Mannings equation, Chezy equation.
Identifiers: Flood-wave traveltime, Water velocity.

By applying the Manning and Chezy formulas, the ratio of the velocity of a flood wave to the mean velocity of water particles is shown to be between 1.3 and 1.7. The results of an actual study with a fluorescent dye in an open channel to determine the ratio show good agreement with the expected ratios in channel reaches without dams, but reaches with dams give ratios greater than 2.0. (USGS)
W69-05240

DYE-CLOUD PHOTOGRAPHY,
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 07B.
W69-05241

POLAR COORDINATE CHART READER FOR STAGE-RAINFALL RECORDER,
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 07B.
W69-05254

INTERPRETATION OF FLOOD-FREQUENCY DATA,
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 07B.
W69-05260

COMPUTERIZED SYSTEM FOR WYOMING SURFACE WATER RECORDS,
Wyoming Univ., Laramie. Water Resources Research Inst.
Paul A. Rechard, William N. Embree, and Lee W. Larson.
Wyoming State Water Plan Report No 1, Cheyenne: State Engineer's Office; and Wyoming WRRI - Water Resources Series No 13, September 1968. 66 p, 2 fig, 3 append.

Descriptors: Annual discharge, Automation, *Computer programs, *Data processing, *Data storage and retrieval, Duration curves, Frequency analysis, Hydrologic data, Information retrieval, Maximum flow, Mean daily flow, Minimum flow, *Streamflow, *Surface waters, Water resources, Water year.

A general description of a computerized system for Wyoming Surface Water Records is given. This system, developed by the University of Wyoming's Water Resources Research Institute, in conjunction with the Computer Center, is designed to store and utilize streamflow data. All available programs and types of out-put are described and procedures for operation of the system are given.
W69-05326

IN DEFENSE OF EXPERIMENTAL WATERSHEDS,
Georgia Univ., Athens. School of Forestry; and Northeastern Forest Experiment Station, Upper Darby, Pa.
For primary bibliographic entry see Field 02A.
W69-05405

UNSTEADY FLOW PARAMETERS IN HYDRAULIC DESIGN,
Kansas Univ., Lawrence.
For primary bibliographic entry see Field 08B.
W69-05408

WATER RESOURCES OF THE SALMON FALLS CREEK BASIN, IDAHO-NEVADA,
Geological Survey, Washington, D. C.
E. G. Crosthwaite.
Geol Surv Water-Supply Pap 1879-D, pp D1-D33, 1969. 33 p, 7 fig, 5 tab, 39 ref.

Descriptors: *Water resources, Groundwater, Surface waters, Aquifers, Idaho, Nevada, Irrigation water, Water yield, Water utilization, Data collections, Hydrologic data, Water levels, Streamflow, Water table.
Identifiers: Volcanic rocks, Salmon Falls Creek (Idaho).

The Salmon Falls Creek basin, Idaho-Nevada, has insufficient surface water to irrigate its good agricultural land. Specific capacities of the existing irrigation and test wells range from 0.5 to 70 gpm per ft. The area's most important aquifer is the Idavada volcanic rocks, and only 5 local areas have been discovered where irrigation water may be pumped economically. About 8,000 acre-ft were withdrawn for all uses in 1960. Natural discharge is estimated to be 115,000 acre-ft per yr. The groundwater has a medium to high salinity hazard and low sodium hazard. The surface water supply averages 107,000 acre-ft per yr, of which 76,000 are used for irrigation. (Knapp-USGS)
W69-05409

WATER-RESOURCES APPRAISAL OF THE SNAKE RIVER BASIN IN NEVADA,
Geological Survey, Carson City, Nev.
Donald O. Moore, and Thomas E. Eakin.
Nev Div Water Resources-Reconnaissance Ser Rep 48,July 1968. 103 p, 13 fig, 1 plate, 29 tab, 25 ref.

Descriptors: *Water resources, *Surface waters, *Groundwater, *Nevada, Water sources, Water utilization, Water yield, Precipitation (Atmospheric), Runoff, Streamflow, Water wells, Aquifers, Induced infiltration, Evapotranspiration, Transmissivity, Data collections.
Identifiers: Snake River Basin (Nev).

The Snake River basin in Nevada includes about 5,000 sq mi in Elko and Humboldt Counties, nearly all above 5,000 ft. The basin has high runoff, high evapotranspiration, and the streams are groundwater drains. Precipitation is estimated to average about 3.9 million acre-ft per yr of which 83% is lost to evapotranspiration where it falls. Potential recharge is estimated to be about 150,000 acre-ft per yr. Groundwater is largely undeveloped. Irrigation wells in volcanic rock yield as much as 2,500 gpm and suggest the possibility of good irrigation development potential. Development to perennial yield might salvage as much as 45,000 acre-ft per year now lost to evapotranspiration, and induce recharge from streamflow. Both surface water and groundwater are of good quality with medium salinity and low alkali hazards, hard, and of low total dissolved solids content. (Knapp-USGS)
W69-05414

FLOODS IN VIRGINIA - MAGNITUDE AND FREQUENCY,
Geological Survey, Richmond, Va.
E. M. Miller.
Geol Surv open-file rep, 1969. 371 p, 12 fig, 2 plate, 4 tab, 19 ref, 1 append.

Descriptors: *Floods, *Stage-discharge relations, *Streamflow, *Data collections, Hydrologic data, Duration curves, Hydrographs, Equations.
Identifiers: Flood peak, Peak stages, Flood frequencies.

Flood magnitude-frequency equations applicable to streams in Virginia are presented. The equations are based on flood data collected at 200 gaging stations having 10 or more years of record not materially affected by regulation, and relate flood magnitude and frequency to drainage area and stream slope. A compilation of flood records at all sites at which 5 or more consecutive years of record have been collected is included. An appendix presents the results of flood-frequency analyses as pertains to Virginia from U. S. Geological Survey Water-Supply Papers 1672, 1673, 1675, and 1676. (Knapp-USGS)
W69-05415

RAINFALL-RUNOFF MODEL FOR SMALL BASIN FLOOD HYDROGRAPH SIMULATION,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 02A.
W69-05420

WATER RESOURCES OF THE BURNETT REGION,
F. B. Haigh, J. A. O'Shea, J. E. Ladewig, R. G. H. Prince, and L. de Henry.
Water Resources Found of Australia Rep No 26, Symp Pap, 1968. 56 p, 9 fig, 6 tab, 10 ref.

Descriptors: *Water resources, *Surface waters, *Groundwater, *Irrigation, *Optimum development plans, River basin development, Recharge, Water yield, Safe yield, Streamflow, Runoff, Reservoirs, Water wells, Storage, Water pollution, Irrigation water, Municipal water, Domestic water.
Identifiers: Australia, Queensland, Burnett region, Bundaberg.

The water resources of the Burnett region, Queensland, eastern Australia, are discussed in a seminar of 5 papers which include the topics of recharge, land and water use, corrosion of well equipment, and stream pollution. The region has an area of about 14,000 sq mi and a population of about 80,000. Sugar cane production accounts for 22% of primary industrial and agricultural output. Rainfall averages 44 inches per year. Average streamflow is 1,663,000 acre-ft per yr. In irrigated areas the surface and groundwater supplies are fully developed and near Bundaberg they are overdeveloped. Full development of the region's water resources would provide an estimated safe supply of 500,000-600,000 acre-ft per yr, while present and near-future commitments amount to about 500,000 acre-ft. Conservation measures including underground storage, evaporation control, runoff improvement, optimum use plans, dry farming, pollution control, and others are being studied. (Knapp-USGS)
W69-05423

A PROPOSED MECHANICS FOR THE INVESTIGATION OF SURFACE RUNOFF FROM SMALL WATERSHEDS. 1, DEVELOPMENT,
Ohio Agricultural Research and Development Center, Wooster.
For primary bibliographic entry see Field 02A.
W69-05425

RUNOFF VOLUME PREDICTION FROM DAILY CLIMATIC DATA,
Agricultural Research Service, Riesel, Tex.; and Agricultural Research Service, Chickasha, Okla.
For primary bibliographic entry see Field 02A.
W69-05426

PREDICTING TEMPERATURES OF SMALL STREAMS,
Oregon State Univ., Corvallis. Forest Research Lab.
George W. Brown.
Water Resources Res, Vol 5, No 1, pp 68-75, Feb 1969. 8 p, 6 fig, 15 ref. Grant WP-423.

Descriptors: *Water temperature, *Water quality, *Streamflow, *Small watersheds, *Heat budget, Energy budget, Heat balance, Heat flow, Heat transfer, Vegetation effects, Conduction, Convection, Evaporation, Meteorology.
Identifiers: Water temperature control, Radiometers.

Hourly temperatures of small streams can be accurately predicted using an energy balance. Micrometeorological measurements are required to assess the environment of the small stream accurately. The temperature-prediction technique was tested on 3 streams in Oregon. On unshaded stretches, net all-wave radiation is the predominant energy source during the day; evaporation and convection account for less than 10% of the total energy exchange. Conduction of heat into the stream bottom is an important energy balance component on shallow streams having a bedrock bottom. Up to 25% of the energy absorbed by such a stream may be transferred into the bed. Hourly temperature changes of 0-16 deg F were predicted to within 1 deg F more than 90% of the time. This technique permits foresters to control water temperature through manipulation of stream-side vegetation. (Knapp-USGS)
W69-05427

USING ANALYTICAL METHODS TO DEVELOP A SURFACE-RUNOFF MODEL,
Tennessee Valley Authority, Knoxville.
For primary bibliographic entry see Field 02A.
W69-05431

SYNTHETIC HYDROGRAPHS; EFFECTS OF NETWORK GEOMETRY,
Thomas J. Watson Research Center, Yorktown Heights, N. Y.
For primary bibliographic entry see Field 02A.
W69-05432

RUNOFF HYDROGRAPH AS A FUNCTION OF RAINFALL EXCESS,
Cambridge Univ. (England).
For primary bibliographic entry see Field 02A.
W69-05438

RECURRENCE INTERVALS BETWEEN EXCEEDANCES OF SELECTED RIVER LEVELS. 2. ALTERNATIVES TO A MARKOV MODEL,
New South Wales Univ. Kensington (Australia); and Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Land Research.
C. A. McGilchrist, K. D. Woodyer, and T. G. Chapman.
Water Resources Res, Vol 5, No 1, pp 268-275, Feb 1969. 8 p, 3 fig, 7 tab, 4 ref.

Descriptors: *Mathematical models, *Statistical models, *Probability, *Markov processes, Streamflow forecasting, Hydrograph analysis, Runoff forecasting, Rainfall-runoff relationships, Duration curves.
Identifiers: Exponential models, Gamma models.

In a study of the probability of exceedance of a selected stage for daily maximum water levels, exponential and gamma models can be shown to be more realistic than a Markov model. The important differences are in the tails of the distributions, and the estimate of the expected recurrence interval is affected little by the choice of model. Confidence limits for the mean recurrence interval are, in fact, somewhat wider for the exponential model than for the Markov model. It is shown that the general relationship between the expected recurrence interval and the return period for the annual maximum series depends on the choice of model (Knapp-USGS)
W69-05454

FREQUENCY CURVES FOR ANNUAL FLOOD SERIES WITH SOME ZERO EVENTS OR INCOMPLETE DATA,
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 07C.
W69-05455

FLOOD PLAIN INFORMATION OF ELLICOTT CREEK IN CITY OF TONAWANDA AND VICINITY, ERIE COUNTY, NEW YORK.
Corps of Engineers, Buffalo, N. Y.

Corps Eng Flood Plain Rep, Jan 1968. 60 p, 58 fig, 10 plate, 12 tab.

Descriptors: *Floods, *Flood damage, Flood plains, Flood control, Non-structural alternatives, New York, Maximum probable flood, Historic flood.
Identifiers: Tonawanda (NY), Erie County, Ellicott Creek (NY), Standard project flood, Intermediate regional flood.

Flooding of Ellicott Creek, vicinity of Tonawanda, Erie County, New York is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-05458

FLOOD PLAIN INFORMATION OF DUCK CREEK, GARLAND, TEXAS.
Corps of Engineers, Fort Worth, Tex.

Corps Eng Flood Plain Rep, Mar 1968. 33 p, 10 fig, 19 plate, 12 tab.

Descriptors: *Floods, *Flood damage, Flood control, Non-structural alternatives, Texas, Maximum probable flood, Historic flood.
Identifiers: Garland (Tex), Duck Creek, Standard project flood, Intermediate regional flood.

Flooding of Duck Creek, Garland, Texas is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-05459

FLOOD PLAIN INFORMATION, SOUTH MESQUITE CREEK, MESQUITE, TEXAS.
Corps of Engineers, Fort Worth, Tex.

Corps Eng Flood Plain Rep, June 1968. 40 p, 6 fig, 21 plates, 11 tab. Prepared for city and county of Dallas Flood Control Committee.

Descriptors: *Floods, *Flood damage, Flood plains, Flood control, Non-structural alternatives, Texas, Maximum probable flood.
Identifiers: Mesquite (Tex), South Mesquite Creek, Standard project flood, Intermediate regional flood.

Flooding os South Mesquite Creek, Mesquite, Texas is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-05460

FLOOD PLAIN INFORMATION, TENMILE CREEK, DALLAS COUNTY, TEXAS.
Corps of Engineers, Fort Worth, Tex.

Corps Eng Flood Plain Rep, May 1968. 45 p, 10 fig, 36 plate, 12 tab. Prepared for the city and county of Dallas Flood Control Committee.

Descriptors: *Floods, *Flood damage, Flood plains, Flood control, Non-structural alternatives, Texas, Maximum probable flood.

Identifiers: Dallas County (Tex), Tenmile Creek, Standard project flood, Intermediate regional flood.

Flooding of Tenmile Creek, Dallas County, Texas is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-05461

FLOOD PLAIN INFORMATION OF CATTARAUGUS CREEK, ARCADE, WYOMING COUNTY, NEW YORK.
Corps of Engineers, Buffalo, N. Y.

Corps Eng Flood Plain Rep, July 1968. 50 p, 28 fig, 7 plate, 2 exhibit, 10 tab.

Descriptors: *Floods, *Flood damage, Flood plains, Flood control, Non-structural alternatives, New York, Maximum probable flood, Historic flood.
Identifiers: Arcade (NY), Wyoming County, Cattaraugus Creek, Standard project flood, Intermediate regional flood.

Flooding of Cattaraugus Creek, Arcade, Wyoming County, New York is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-05462

2F. Groundwater

TIME-OF-TRAVEL MEASUREMENTS AND OTHER APPLICATIONS OF DYE TRACING,
Geological Survey, Cheyenne, Wyo. Water Resources Division.
For primary bibliographic entry see Field 07B.
W69-05228

IDENTIFICATION OF NONLINEAR PARAMETERS OF GROUND WATER BASINS BY HYBRID COMPUTATION,
California Univ., Los Angeles.
Venkateswararao Vemuri, and Walter J. Karplus.
Water Resources Research, Vol 5, No 1, pp 172-185, Feb 1969. 8 fig, 13 ref.

Descriptors: *Groundwater basins, *Aquifers, *Computer models, *Parametric hydrology, *Water table, Analog computers, Digital computers, Data processing, Equations, Hydrologic data, Transmissivity, Input-output analysis, Systems analysis, Boundaries (Surfaces), California, Contours, Storage coefficient, Mathematical models.
Identifiers: *Parameters, *Hybrid computers, Algorithms, San Fernando Valley, California.

Identification of parameters of an unconfined aquifer in which the dynamics of the water table were describable by a partial differential equation can be looked upon as a control system problem in distributed parameters systems. A maximum principle was used in conjunction with a steepest descent algorithm and the transmissibility of an aquifer was identified starting from observed values of input-output as data. This algorithmic procedure was blended with a heuristic method to identify the storage coefficient and the boundary of an aquifer in the San Fernando Valley basin in the city of Los Angeles. Some typical results of computations carried out on the hybrid computer were presented. This work demonstrates the computational advantages in combining analog and digital hardware, not only in terms of the gain in computational time but also in terms of the flexibility offered by the system. (Affleck-Ariz)
W69-05271

VARIATION IN THE COMPOSITION OF BRINE FROM THE SYLVANIA FORMATION NEAR MIDLAND, MICHIGAN,
Dow Chemical Co., Midland, Mich.
G. C. Egleson, and C. W. Querio.
Environ Sci and Technol, Vol 3, No 4, pp 367-371, Apr 1969. 5 p, 3 fig, 4 tab, 5 ref.

Descriptors: *Brines, *Water chemistry, *Groundwater, Saline water systems, Geochemistry, Michigan, Calcium, Magnesium, Sulfates, Potassium, Boron, Ammonium compounds, Trace elements, Salinity, Sea water, Aqueous solutions.
Identifiers: Sylvania Formation (Mich), Bromine, Strontium, Rubidium, Lithium, Iodine.

Brines from 51 wells in The Dow Chemical Co.'s brine field near Midland, Mich., were analyzed for major and minor components. The Ca, Mg, Na, Sr, Cl, and Br ions, which make up the bulk of the total dissolved solids in the brine, are fairly constant throughout the field, varying less than 10% above or below the mean. Another suite of ions-K, B, Ammonium, Rb, Li, and I-varies from 25 to 50% above and below the mean. Analyses of trends and relationships among the ions indicate that dolomitization probably is the mechanism most important in determining the Ca, Mg, and Sr content of the brine; that the relative amounts of Li, I, and ammonium are too high for them to have been derived directly from sea water evaporation; and that many interrelationships among the minor ions as yet are not well defined. (Knapp-USGS)
W69-05401

WATER RESOURCES OF THE SALMON FALLS CREEK BASIN, IDAHO-NEVADA,
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 02E.
W69-05409

TRANSIENT FLOW OF GROUND WATER TO WELLS IN MULTIPLE-AQUIFER SYSTEMS,
California Univ., Berkeley.
Shlomo P. Neuman, and Paul A. Witherspoon.
Dep Civil Eng, Inst Transp and Traffic Eng Publication No 69-1, Jan 1969. 182 p, 40 fig, 52 ref, 3 append.

Descriptors: *Groundwater movement, *Mathematical studies, *Mathematical models, *Unsteady flow, Water wells, Numerical analysis, Aquifers, Aquitards, Permeability, Drawdown, Theis equation, Thiems equation, Water level fluctuations, Withdrawal.
Identifiers: Multiple-aquifer systems, Finite-difference methods, Leaky aquifers.

The transient flow of fluid to wells in multiple-aquifer systems was analyzed for 2-aquifer and 3-aquifer systems by finite-difference methods. Asymptotic solutions for small time values were obtained to give the drawdown distribution in an aquifer enclosed by 2 aquitards. Solutions for 2-aquifer systems were evaluated by a numerical method and the results are presented graphically. The finite element method was used to study 2-aquifer systems and to check analytical solutions. The assumption that flow is essentially horizontal in aquifers and vertical in aquitards was found to hold approximately in most field situations. Presently used test methods for leaky aquifers are limited in application, and new methods are outlined. (Knapp-USGS)
W69-05413

WATER-RESOURCES APPRAISAL OF THE SNAKE RIVER BASIN IN NEVADA,
Geological Survey, Carson City, Nev.
For primary bibliographic entry see Field 02E.
W69-05414

EVALUATION OF SOME GEOPHYSICAL TECHNIQUES APPLIED TO THE ENVIRONMENT OF A MAUI WELL,
Hawaii Inst. of Geophysics, Honolulu.
W. M. Adams, and A. Malahoff.
Hawaii Inst Geophys Rep No HIG-68-23, Nov 1968. 29 p, 10 fig, 7 tab, 9 ref, 3 append. OWRR Project B-005-HI.

Descriptors: *Borehole geophysics, *Electrical resistance, *Seismic studies, *Groundwater, *Hawaii, Saline water-freshwater interfaces, Resistivity, Exploration, Geothermal studies, Logging (Recording), Subsurface investigations, Water quality, Water yield, Water temperature, Water table, Aquifers.
Identifiers: Groundwater exploration, Maui (Hawaii).

A review of the various geophysical techniques applicable to groundwater exploration in Hawaii was made to determine which were suitable for further development. Improvements on some aspects of sugar production and agriculture indicated the need for improving the production of water on the island without loss of quality. The environment of a Maui well was studied with five types of geophysical techniques. These were lateral and vertical temperature surveying, seismic refraction, seismic reflection, and electrical resistivity sounding. Results of the lateral temperature surveying were not informative but those of the vertical temperature surveying indicated inflowing water and additional development possibilities. The seismic techniques were not useful at the attempted small effort. The electrical resistivity sounding located the fresh-salt interface and indicated a shallow, unexpected discontinuity in the electrical resistivity. The water table was not located directly. No resistivity profiling was attempted. On the basis of this limited work, it is suggested that one of the borings from the surface could be extended to a deeper aquifer at minimal cost. Comparison of the effectiveness of the various methods suggests that the vertical temperature surveys and the electrical resistivity sounding were most informative for the amount of effort involved. (Knapp-USGS)
W69-05418

WATER RESOURCES OF THE BURNETT REGION,
For primary bibliographic entry see Field 02E.
W69-05423

MEASUREMENT OF SMALL SURFACE DISPLACEMENTS INDUCED BY FLUID FLOW,
Missouri Univ., Columbia; Hawaii Univ., Honolulu, Water Resources Research Center; and Arizona Univ., Tucson. Agricultural Extension Service.
Stanley N. Davis, Frank L. Peterson, and Allan D. Halderman.
Water Resources Res, Vol 5, No 1, pp 129-138, Feb 1969. 10 p, 7 fig, 1 tab, 18 ref. Grant GP-985 (NSF).

Descriptors: *Groundwater movement, *Aquifers, *Strain, Withdrawal, Strain measurement, Stress analysis, Strain gages, Elasticity (Mechanical), Subsidence.
Identifiers: Fluid movement-aquifer strain relationships, Aquifer dynamics.

Fluid flow to wells produces strain that has been measured as horizontal, vertical, and rotational displacements of reference points fixed on the ground surface. Most linear displacements measured were between 1 and 100 microns, and angular displacements were a few microradians. Of the various devices used to make measurements, a horizontal extensometer proved to be the most accurate and versatile. Most measurements were made of effects

produced by pumping wells for 5 to 30 minutes. Such effects are almost entirely elastic except in some geologically recent materials. Deflections of the land surface resembled the theoretical deflections caused by a point load on a plate of infinite extent resting on an elastic foundation. Significant horizontal strain was measured in all materials tested, suggesting that accepted equations for fluid discharge from wells might be modified for special conditions near the wells. (Knapp-USGS)
W69-05433

HYDRODYNAMIC DISPERSION IN A SATURATED HOMOGENEOUS POROUS MEDIUM AT LOW PECLET NUMBERS AND NON-HOMOGENEOUS SOLUTION,
Guelph Univ. (Ontario).
For primary bibliographic entry see Field 01B.
W69-05434

COMPUTER METHODS FOR TRANSIENT ANALYSIS OF WATER-TABLE AQUIFERS,
California Univ., Davis; and Ohio State Univ., Columbus.
For primary bibliographic entry see Field 07C.
W69-05435

THE MECHANISM OF NATURAL GROUND-WATER RECHARGE AND DISCHARGE-1. ONE-DIMENSIONAL, VERTICAL, UNSTEADY, UNSATURATED FLOW ABOVE A RECHARGING OR DISCHARGING GROUND-WATER FLOW SYSTEM,
Dept. of Energy, Mines and Resources, Calgary (Alberta). Inland Waters Branch.
R. Allan Freeze.
Water Resources Res, Vol 5, No 1, pp 153-171, Feb 1969. 18 p, 9 fig, 2 tab, 33 ref.

Descriptors: *Unsteady flow, *Saturated flow, *Unsaturated flow, *Infiltration, Mathematical models, Evaporation, Water-level fluctuations, Percolation, Recharge, Discharge (Water), Darcy's law, Soil water movement, Groundwater movement, Rainfall intensity.
Identifiers: Transient flow.

The unsaturated flow processes of infiltration and evaporation are in physical and mathematical continuity with the parallel saturated processes of recharge and discharge. Water table fluctuations result when the rate of groundwater recharge or discharge is not matched by the unsaturated flow rate created by infiltration or evaporation. A water-table rise provides the source of replenishment to the groundwater zone that allows the prevailing rate of recharge to continue. This dynamic water-table behavior can be simulated by a one-dimensional, numerical mathematical model involving transient flow through an integrated saturated-unsaturated system. The solutions are applicable to homogeneous, isotropic soils in which the functional relationships show hysteresis properties. The model allows upper boundary conditions of constant rate rainfall, ponded water, evaporation, and redistribution. It can be used to determine the water-table fluctuation that will arise from a given set of initial conditions, boundary conditions, and soil type. The effects of variations in the parameters that control the flow are examined to arrive at a better understanding of the mechanism of natural groundwater recharge and discharge. (Knapp-USGS)
W69-05436

FLUID FLOW IN THE WESTERN CANADA SEDIMENTARY BASIN - 1. EFFECT OF TOPOGRAPHY,
Research Council of Alberta, Edmonton.
Brian Hitchon.
Water Resources Res, Vol 5, No 1, pp 186-195, Feb 1969. 10 p, 8 fig, 16 ref.

Descriptors: *Groundwater movement, *Flow nets, *Topography, Groundwater basins, Water levels, Water level fluctuations, Streamflow, Drawdown, Potential flow, Potentiometric level.
Identifiers: *Western Canada basin.

In the western Canada sedimentary basin, the main variables affecting the groundwater potential distribution are topography and geology. The effect of topography is studied by use of fluid potential slice maps and cross sections taken from the 3-dimentional flow net. The dominant fluid potential in any part of the basin corresponds closely to the fluid potential at the topographic surface in that part of the basin. Major recharge areas correspond to major upland areas, and major lowland regions are major discharge regions. Large river valleys commonly exert a drawdown effect on the fluid potential distribution, which may be observed to depths of up to 5000 ft. The presence of a thick sequence of highly permeable Upper Devonian and Carboniferous carbonate rocks in the medium-depth portion of the Alberta basin has resulted in the development of a low fluid-potential drain, which essentially channels flow from most of the Alberta basin towards the Athabasca oil sands and has modified the theoretical relation between local and regional flow systems. (Knapp-USGS)
W69-05451

DETERMINING THE RATIO OF HORIZONTAL TO VERTICAL PERMEABILITY BY AQUIFER-TEST ANALYSIS,
Geological Survey, Madison, Wis.
Edwin P. Weeks.
Water Resources Res, Vol 5, No 1, pp 196-214, Feb 1969. 19 p, 6 fig, 1 tab, 22 ref.

Descriptors: *Groundwater movement, *Permeability, Anisotropy, Aquifers, Beds, Unsteady flow, Porosity, Interstices, Piezometers, Piezometry, Theis equation, Drawdown, Water level fluctuations.
Identifiers: Aquifer anisotropy, Vertical permeability, Horizontal permeability, Aquifer testing, Pumping tests, Partially penetrating wells.

The ratio of horizontal to vertical permeability may be determined by analysis of drawdown data from piezometers or partially penetrating observation wells near a partially penetrating production well. The analyses are made by comparing measured drawdowns in the piezometers to those predicted if the production well fully penetrated the aquifer. The differences between the measured and predicted drawdowns are determined, and the distances from the pumped well at which these differences would occur in an isotropic aquifer are determined from an equation. The permeability ratio is computed as the square of the ratio of actual distances to computed distances. The ratio of horizontal to vertical permeability in glacial outwash in central Wisconsin was determined from 5 aquifer tests to range from about 2 to about 20. (Knapp-USGS)
W69-05452

SALT WATER ENCROACHMENT IN KARST AQUIFERS, ISLAND OF KEPHALLINIA, (IONIAN),
Society of Hydrogeological Scientists Graz, (Austria).
For primary bibliographic entry see Field 02L.
W69-05472

SALT-WATER ENCROACHMENT OF TERTIARY LIMESTONE ALONG COASTAL SOUTH CAROLINA,
Geological Survey, Columbia, S. C.
For primary bibliographic entry see Field 02L.
W69-05473

DETERMINATION OF FRESH WATERS IN THE CALCAREOUS MASSIF OF 'COSTA BRAVA', SPAIN (FRENCH),
Federico Macau Vilar.
Hydrol of fractured rocks Vol 2, Proc Dubrovnik Symp (Oct 1965), Int Ass Sci Hydrol, Pub 74, pp 455-462, 1967. 8 p, 2 fig.

Descriptors: *Aquifers, *Fresh water, *Limestones, *Hydrologic properties, Hydrogeology, Springs, Saline water-fresh water interfaces, Groundwater movement, Water sources, Water storage, Geochemistry, Discharge, Water chemistry, Water wells.
Identifiers: *Spain, Montgri calcareous massif, Costa Brava.

This article describes the methods used and results of an investigation of groundwater resources in the calcareous massif in Spain, and the preliminary results of mapping the fresh water aquifers and the saline water occurrence along the coast. The hydrological survey used in the area consisted of several trial boreholes along profiles selected on the basis of submarine fresh-water springs pinpointed by special frogman teams. The study shows that the marine environments, such as temperature, plant and animal life, etc., deviate from normal marine patterns at the places of emergence of fresh water springs. A detailed geological map and a cross section showing fresh water and the saline water-fresh water interface are presented. (Gabriel-USGS)
W69-05474

STATISTICAL ANALYSIS OF GROUND WATER USE AND REPLENISHMENT,
Purdue Univ., Lafayette, Ind.
J. D. Rockaway, and R. B. Johnson.
Water Resources Res Center Tech Rep No 2, Purdue Univ, Sept 1967. 142 p, 28 fig, 28 ref, 4 append. OWRR Project A-002-IND.

Descriptors: *Statistical methods, *Statistical models, *Water resources development, Forecasting, Groundwater, Water table, Flow nets, Aquifers, Recharge, Water yield, Water utilization, Water level fluctuations, Observation wells, Precipitation (Atmospheric), Digital computers.
Identifiers: *Trend-surface analysis, Aquifer evaluation.

A trend-surface analysis of hydrogeologic data was carried out in an attempt to derive techniques which could give additional guidance in the selection of areas suitable for the development of future groundwater resources. South Bend, Indiana is an area of municipal and industrial groundwater requirements and Bartholomew County, Indiana is an area of essentially rural or small-scale demands. Both areas obtain water from glacial sand and gravel aquifers in which water levels have been monitored for several years. Trend-surface maps and maps of the residuals from the trend surfaces were prepared from the water-level data at regular intervals and evaluated to establish their relationships with the hydrogeologic regimen. The maps were compared with conventional piezometric maps drawn from the same data, with known subsurface conditions and aquifer parameters, and the fluctuations of these maps with time were compared with variations in the recharge and discharge characteristics of the groundwater reservoir. A field-testing program was carried out in Bartholomew County to evaluate an area determined by the trend-surface analysis to be favorable for the development of groundwater. A mathematically computed surface is used to approximate the piezometric surface. The addition of orthogonal flow lines to the contours of the trend-surface maps can provide additional information on the direction and relative amounts of groundwater flow. The trend-surface approach to the analysis of groundwater levels cannot be completely successful unless the requirements for suitable data are satisfied. (Knapp-USGS)
W69-05475

WATER RESOURCES LAWS IN VIRGINIA (PERCOLATING GROUNDWATER - DIFFUSED SURFACE WATER).
For primary bibliographic entry see Field 06E.

W69-05535

2G. Water in Soils

CHARACTERISTICS OF LOGARITHMIC RATING CURVES,
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 07B.
W69-05259

MEASUREMENT OF DROUGHT RESISTANCE IN CROP PLANTS,
Indian Agricultural Research Inst., New Delhi. Div. of Botany.
R. D. Asana.
UNESCO Arid Zone Research, Vol 25, pp 413-419, 1965. 1 fig, 2 tab, 18 ref, disc.

Descriptors: *Dry farming, *Monsoons, *Moisture stress, *Drought resistance, *Crop response, Wheat, Plant growth, Wet seasons, Dry seasons, Temperature, Precipitation (Atmospheric), Soil moisture, Droughts.
Identifiers: *India.

Kharif (summer) and rabi (winter) crops grown in India were discussed in this report. Annual rabi crops grow under unirrigated cultivation on soil moisture accumulated during the preceding monsoon, and therefore on soil moisture that gradually decreases with time, increasing moisture stress. Varieties with early to early-medium maturity would be better suited to such conditions than late maturing varieties which would be exposed to more intense soil and atmospheric drought. The kharif crops, which are raised during monsoon rains in summer, do not grow under a gradually increasing soil moisture stress up to maturity. The kharif crops may be injured or their growth may be suppressed temporarily during a long break in the rains. The growth aspect must not be overlooked while evolving criteria for adaptability of varieties to unirrigated cultivation and to low rainfall areas where distribution of rainfall is very erratic. (Blecker-Ariz)
W69-05265

SOIL MOISTURE CONDITIONS UNDER PASTURES OF COOL-SEASON AND WARM-SEASON GRASSES,
Nebraska Univ., Lincoln; Washington State Univ., Pullman.
E. C. Conard, and Vern E. Youngman.
J Range Management, Vol 18, No 2, pp 74-78, March 1965. 2 fig, 4 tab, 2 ref.

Descriptors: *Moisture content, *Soil moisture, *Pastures, *Grazing, *Grasses, Drought tolerance, Moisture availability, Nebraska, Precipitation (Atmospheric), Sampling, Clay loam, Soil-water-plant relationships, Depth, Autumn, Field capacity, Crop response, Spring, Plant growth, Variability.

Variations in the soil moisture content of a silty clay loam under two kinds of pasture, cool-season and warm-season grasses, were studied in conjunction with a grazing experiment at Lincoln, Nebraska. Warm-season pastures consisted of big bluestem, side-oats grama, Nebraska 28 switchgrass and Nebraska 27 sand lovegrass. Cool-season grasses were Lincoln bromegrass, tall wheatgrass, and intermediate wheatgrass. There was less available water in soil under the cool-season than under warm-season grasses in the mid-spring of each year. Amounts under warm-season grasses ranged from 25% to 240% more than under cool-season grasses. Cool-season pastures suffered from midsummer drought more often than did warm-season pastures. Since the grasses used in the study are grown in arid areas, results of the experiment would give an indication performance of these grasses under drought conditions. (Blecker-Ariz)
W69-05266

MOISTURE-RETENTION CAPACITY OF LITTER UNDER TWO ARIZONA CHAPARRAL COMMUNITIES,
R. M. Garcia, and C. P. Pase.
U. S. Forest Service, Research Note RM-85, 2 pp, 1967. 1 fig, 1 tab, 3 ref.

Descriptors: *Soil moisture, *Moisture content, *Chaparral, *Retention, *Field capacity, Plant growth, Percolation, Arizona, Canopy, Biological communities, Water yield, Weight, Soil-water-plant relationships.
Identifiers: *Litter layer, Manzanita.

Retention of moisture in the litter layer affects soil-moisture supply and therefore plant growth and percolation water yield. Moisture-retention capacity of chaparral litter was studied at three sites in the Tonto National Forest, Arizona. Arrangement of litter appeared to have little effect on water-holding capacity, and therefore disturbed and undisturbed litter samples would be expected to yield reasonably similar results. Within each community, litter weight varied substantially more than did water retained per gram of litter. Pringle manzanita litter held more water per gram of litter than did shrub live oak but total litter produced was less. Increasing the litter layer under plants may be a possible way of increasing vegetative production on arid lands by increasing the moisture content of soil near the plants. (Blecker-Ariz)
W69-05267

SOIL PROBLEMS IN RESEEDING A GREASEWOOD-RABBITBRUSH RANGE SITE,
Agricultural Research Service, Washington, D. C. Soil and Water Research Div., Agricultural Research Service, Washington, D. C. Crops Research Div.
M. B. Rollins, A. S. Dylla, and R. E. Eckert, Jr.
J of Soil and Water Conservation, Vol 23, No 4, pp 138-140, July-August, 1968. 2 fig, 1 tab, 13 ref.

Descriptors: *Wheatgrasses, *Range management, *Soil surfaces, *Infiltration, *Grasses, *Dunes, Seeds, Semiarid climates, Shrubs, Soil physical properties, Soil chemical properties, Sodium compounds, Boron, Salts, Ranges, Nevada, Desert plants, Revegetation, Sampling.
Identifiers: *Rabbitbush, *Greasewood, Reseeding.

A study was conducted on relationship of tall wheatgrass seedling survival to physical and chemical properties of surface soils at a greasewood-rabbitbrush range site. The study site was located in the semiarid northern desert of Nevada. Small dunes, which comprised about one-third of the study site, were more textured than the barren soils. Native vegetation consisted of greasewood, rabbitbrush, Great Basin wildrye and saltgrass. Exchangeable sodium percentage levels in the 3 inches of surface soil were closely related to infiltration rates. Grasses were successfully established only on dune soils. Excessive exchangeable sodium, total salts or boron in barren surface soils accounted for death of tall wheatgrass seedlings. Total salts and exchangeable sodium (0-6-inch depth) were lower beneath greasewood and rabbitbrush plants than in adjacent barren soil. (Blecker-Ariz)
W69-05269

EFFECT OF FATTY ALCOHOL ON CHANGE IN SOIL WATER DURING THE SUMMER FALLOW PERIOD,
Colorado State Univ., Springfield. Southeastern Colorado Branch Station.
K. G. Brengle, and H. O. Mann.
J Soil and Water Conserv, Vol 24, No 1, pp 25, 26, Jan-Feb, 1969. 1 tab, 6 ref.

Descriptors: *Octadecanol, Fallowing, *Soil water, *Summer, *Evaporation control, Alcohols, Colorado, Semiarid climates, Retardants, Rates of application, Precipitation (Atmospheric), Water loss, Water storage, Soil surfaces, Evaporation pans, Cultivation.
Identifiers: *Powder.

A study was conducted to determine whether fatty alcohols would improve efficiency of soil water storage during the fallow period under semiarid conditions in southeastern Colorado. Octadecanol in powder form was applied at rates of 0, 300, 600, and 900 pounds per acre in a randomized block experiment with 5 replications. No significant differences in soil water changes were noted in any of the 3 years during which the test was conducted, but there was a trend for less water loss with 900 pounds of fatty alcohol per acre. Surface application of fatty alcohol at the rates used in this study did not retard soil water loss enough to warrant its use in a fallow system. (Affleck-Ariz)
W69-05284

STUDIES ON METHODS OF SOIL WATER DETERMINATION,
Idaho Univ., Moscow. Water Resources Research Inst.
Howard E. Hite, Jr.
Idaho Univ Engineering Experiment Station, M. A. Thesis, April 1968. 133 p, 7 tab, 37 fig, 64 ref. OWRR Project A-019-IDA.

Descriptors: *Soil water, *Moisture content, *Lustrumentation, Thermal conductivity, Infrared, Zeta potential, Nuclear magnetic resonance.
Identifiers: Soil water measurement.

Various methods for determining the water content of soils are examined. Development work on probe type instruments utilizing the principles of thermal conductivity and infrared reflectance is reported. Aside from the necessity of calibrating for each soil type, relatively fast determinations can be made with simple apparatus utilizing these principles. Difficulties encountered in providing laboratory simulation of varying said conditions are discussed. The use of the streaming potential or the principle of Nuclear Magnetic Resonance hold virtually no promise for a workable instrument.
W69-05304

STUDIES OF METHODS OF SOIL WATER DETERMINATION,
Idaho Univ., Moscow. Water Resources Research Inst.
J. I. Hagen.
Research Technical Completion Report, June 1968. 45 p, 2 tab, 19 fig, 76 ref. OWRR Project A-019-IDA.

Descriptors: *Soil moisture, moisture content, soil moisture meters, *Soil water, Instrumentation, Specific heat, Thermal capacity.

The work reported was undertaken with the intent to develop for soil water determination a more reliable instrument for remote site operation. A survey of the literature led to the selection of four fields of study: streaming potential, thermal conductivity and specific heat, absorption of infrared radiation by moist soil, and some adaption of the principle of nuclear magnetic resonance. Experimentation revealed that the factors controlling streaming potential were so diverse that isolation of soil moisture or moisture flow variables was not feasible in field applications. Extensive laboratory testing of an original thermal measuring device showed that this principle could be successfully and reliably used in certain ambient temperature ranges. The data also revealed that, when soil is partially frozen at 32 deg F, information could be derived on the percentage of the soil water in the frozen state, provided the soil moisture content was known. Nuclear magnetic resonance may be discounted as a means of measuring soil moisture content because of fundamental difficulties.
W69-05305

SOIL OR FOLIAR FERTILIZATION OF WELL-DRAINED AND FLOODED SLASH PINE,
Forest Service (USDA), Olustee, Fla. Naval Stores and Timber Production Lab.
Robert P. Schultz.
Forest Service, USDA, Research Paper SE-32, pp 1-8, Apr 1968. 8 p, 3 tab, 13 ref.

Descriptors: *Soil water, Soil moisture, Nitrogen, Fertilizers, Fertilization, Phosphorus, *Application methods, *Crop production, Forest management, Flooding, Wetlands, Plant growth, *Drainage effects, *Foliar application.
Identifiers: *Slash pine trees.

One-year-old slash pine seedlings were grown for 9 months under 2 soil-moisture and 4 N+P fertilization treatments. Flooding increased seedling mortality and decreased growth. Foliar fertilized seedlings did not grow better than unfertilized seedlings either under well-drained or flooded conditions. Under well-drained conditions, seedlings receiving soil fertilization or foliar plus soil fertilization had more than double the dry-weight increment and one-quarter more height growth than unfertilized seedlings. Under flooded conditions, soil fertilization or foliar plus soil fertilization did not increase height growth but increased dry-weight increment by 40% to 50% over unfertilized seedlings.
W69-05332

HYDROLOGY OF A SLIDE-PRONE GLACIAL TILL SOIL IN SOUTHEAST ALASKA,
Forest Service (USDA) Juneau, Alaska. Pacific Northwest Forest and Range Experiment Station.
J. H. Patric, and D. N. Swanston.
J Forest, Vol 66, No 1, pp 62-66, Jan 1968. 5 p, 7 fig, 6 ref.

Descriptors: *Landslides, *Glacial soils, *Soil water, *Soil water movement, *Hydrologic aspects, Land subsidence, Drainage, Permeability, Mass wasting, Irrigation, Soil mechanics, Saturated soils, Saturation, Soaking, Alaska.
Identifiers: Glacial till, Slide-prone soils.

Heavy irrigation caused no surface runoff, erosion, or debris avalanches on well-drained Karta soil, a tentative series producing much of the commercial timber in southeast Alaska. Interpreting measured rainfall, streamflow, and piezometric head in terms of Darcy's equation showed how this slide-prone soil accommodates large amounts of water. About 2/3 of the water applied drained laterally through permeable surface layers to a stream adjacent to the study area. The remaining 1/3 presumably drained deeply into highly fractured bedrock. Less permeable soil, less fractured bedrock, or longer irrigated slopes probably would have caused saturated soil under heavy watering. It appears that Karta soil must be saturated to cause debris avalanches, a condition which may occur naturally when much larger areas are wetted by much smaller rainfall. (Knapp-USGS)
W69-05406

PORE SIZE DISTRIBUTIONS AS MEASURED BY THE MERCURY INTRUSION METHOD AND THEIR USE IN PREDICTING PERMEABILITY,
Oregon Agricultural Experiment Station, Corvallis; Pacific Northwest Forest and Range Experiment Station, Corvallis, Ore.; and Louvain Univ. (Belgium).
G. O. Klock, L. Boersma, and L. W. DeBacker.
Supported in part by grant from OWRR, Dept of Interior. Soil Sci Soc Amer Proc, Vol 33, No 1, pp 12-15, Jan-Feb 1969 4 p, 5 fig, 2 tab, 8 ref.

Descriptors: *Permeability, *Porous media, *Porosity, Equations, Regression analysis, Soil water movement, Permeameters, Capillary action, Saturated flow, nsaturated flow.
Identifiers: Mercury intrusion porosimeter, Pore size distribution, Millington and Quirk equation.

Equations for predicting the permeability of porous media using pore size distribution are reviewed and a mercury intrusion method for obtaining pore size distribution information from samples is described. Calculated and measured permeability values of 35 glass bead and 28 sand samples were compared and agree closely. Permeabilities and pore size distributions of 54 systematically selected particle size classes of glass beads and sand were measured. Limits of the particle size classes ranged from 44-53 to 208-246 microns for the particle diameters. Millington and Quirk's equation was used to calculate the permeabilities. The calculated permeabilities agree with the measured values only when a correction factor is used. (Knapp-USGS)
W69-05439

ANALYZING STEADY-STATE FLOW IN AN INCLINED SOIL SLAB WITH AN ELECTRIC ANALOG,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
F. D. Whisler.
Soil Sci Soc Amer Proc, Vol 33, No 1, pp 19-25, Jan-Feb 1969. 7 p, 12 fig, 17 ref.

Descriptors: *Steady flow, *Soil water movement, *Analog models, Saturated flow, Unsaturated flow, Surface-groundwater relationships, Hydraulic conductivity, Isotropy, Anisotropy, Rainfall-runoff relationships, Infiltration, Flow nets.
Identifiers: Homogeneous isotropic soil, Soil water flow models.

An electrical resistance network analog was used to analyze the steady-state flow in sloping land modeled as an inclined soil slab for both saturated and unsaturated conditions. At saturation the equipotentials and surface fluxes are symmetrical about the vertical midplane of the slab and agree with an analytic solution. For 'rainfall' rates lower than that necessary to saturate the slab, this symmetry is lost. For unsaturated flow a step function representation of the pressure head-conductivity relationship gives comparable results to a more complicated function. As the angle of slope is increased, even though part of the slab may be unsaturated, the internal flow rate increases, especially at the lower outflow end of the slab. Although the results are presented for homogenous-isotropic soils, they can be used for anisotropic soils by using a transformation process. (Knapp-USGS)
W69-05440

MOVEMENT OF WATER AND SALT THROUGH A CLAY-WATER SYSTEM: EXPERIMENTAL VERIFICATION OF ONSAGER RECIPROCAL RELATION,
California Univ., Riverside; Colorado State Univ., Fort Collins; and Agricultural Research Service, Washington, D. C.
J. Letey, and W. D. Kemper.
Soil Sci Soc Amer Proc, Vol 33, No 1, pp 25-29, Jan-Feb 1969. 5 p, 2 fig, 2 tab, 12 ref.

Descriptors: *Soil water movement, *Osmotic pressure, Osmosis, Expansive clays, Clays, Salinity, Diffusion, Fluid mechanics, Porous media, Flow measurement, Permeability, Porosity, Thermodynamics.
Identifiers: Onsager relationship, Clay-water-salt systems, Concentration gradients.

Linear equations are derived to describe the movement of water and salt through soil systems with both hydrostatic and osmotic pressure gradients. The theory of nonequilibrium thermodynamics is used to describe the flows and to test the validity of Onsager reciprocal relations for clay-water-salt systems. Calculated values were compared with data from flow cell experiments using the 2-micron fraction of sodium-saturated Wyoming bentonite. The Onsager reciprocal relation was found to hold; that is, the osmotic flow coefficient is equal to the solute diffusion coefficient in clay-water-salt systems. (Knapp-USGS)
W69-05441

THE EFFECT OF OSMOTIC PRESSURE GRADIENTS ON WATER MOVEMENT IN UNSATURATED SOIL,
California Univ., Riverside. Dept. of Soil Physics, and Colorado State Univ., Fort Collins.
J. Letey, W. D. Kemper, and L. Noonan.
Soil Sci Soc Amer Proc, Vol 33, No 1, pp 15-18, Jan-Feb 1969. 4 p, 2 fig, 5 tab, 6 ref.

Descriptors: *Soil water movement, *Unsaturated flow, *Osmotic pressure, Osmosis, Clays, Salinity, Evaporation, Percolation, Diffusion, Flow measurement, Fluid mechanics, Permeability.
Identifiers: Concentration gradients.

Water movement, in response to osmotic pressure gradients, was measured in clay loam and sandy loam soils at soil water suctions from 0.08 to 15 bars. Movement in response to osmotic pressure gradients were compared to movement in response to hydraulic pressure gradients in the soil water suction range from 0.08 to 0.65 bars. At suction less than 0.5 bars, the amount of water moved by osmotic pressure gradients was generally less than 4% of the water moved by hydraulic gradients of equal magnitude. (Knapp-USGS)
W69-05442

HYDRAULIC CONDUCTIVITY RELATED TO POROSITY AND SWELLING OF SOIL,
Agricultural Research Service, Beltsville, Md. Soils Lab.; and Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
J. V. Lagerwerff, F. S. Nakayama, and M. H. Frere.

Soil Sci Soc Amer Proc, Vol 33, No 1, pp 3-11, Jan - Feb 1969. 9 p, 6 tab, 29 ref.

Descriptors: *Hydraulic conductivity, *Soil water movement, *Porosity, *Expansive soils, Permeability, Percolation, Infiltration, Diffusion, Unsaturated flow, Darcy's law, Soil physical properties, Soil physics, Soil properties.
Identifiers: Kozeny-Carman equation, Swelling soils.

The hydraulic conductivity factor in Darcy's equation for viscous flow is analyzed in terms of a modified Kozeny equation. The modifications include a correction for swelling, and the replacement of the cubic exponent of the porosity term by an exponent varying between 0 and 3. The choice depends on the interplay between surface and volume of soil pores, as determined by flocculation-dispersion conditions. Swelling is calculated from the theory of the diffuse double layer. A theoretical analysis of experimental results on the hydraulic conductivity of 2 soils for percolants of variable concentration and composition showed that a single value for the electrical potential parameter sufficed to match theoretical with experimental data when the concentration of the percolant ranged from 10 to 100 meq/liter. Taking into account effects of pore size, pore density, effective porosity, and flow matrix on the hydraulic conductivity, the above has been explained in terms of expansive swelling of smaller pores at the expense of larger ones. A number of published studies have been analyzed in the light of the theory proposed. The relevance of the theory with regard to the alleged contrast between grain and pore models of soil has been considered. (Knapp-USGS)
W69-05443

2H. Lakes

HYDROMETEOROLOGICAL STUDIES IN SUPPORT OF THE INTERNATIONAL FIELD YEAR FOR THE GREAT LAKES,
Meteorological Service of Canada, Toronto (Ontario). Hydrometeorology Section.
For primary bibliographic entry see Field 02B.
W69-05222

TECHNIQUES OF WATER MANAGEMENT OF LAKE OKEECHOBEE AND THE FLORIDA EVERGLADES,
Corps of Engineers, Jacksonville, Fla. South Atlantic Div.
For primary bibliographic entry see Field 04A.
W69-05223

LIMNOLOGICAL STUDIES OF LENTIC WATERS,
Idaho Univ., Moscow. Water Resources Research Inst.
Fred W. Rabe, and Robert C. Wissmar.
Research Technical Completion Report, September 1968. 23 p, 8 tab, 4 fig, 10 ref. OWRR Project A-018-IDA.

Descriptors: *Microcrustaceans, Standing crop, *Mountain lakes, Sampling, Dispersion, Plankton, Limnology.
Identifiers: Ecology, *Oligotrophy, *Zooplankton, Limnology.

Standing crop of micro-crustaceans was compared in four mountain lakes in northeast Idaho. Results over two summers indicated that the lower meadow lakes had higher densities of crustaceans than the headwall lakes. These findings were based on vertical plankton hauls. Four different field methods of collection together with various sample sizes were also compared. Reliability of data was possibly affected by small sample sizes and avoidance behavior of the crustaceans to the samplers. The four lakes had a similar species composition and low density of crustaceans. Fisher's coefficient of dispersion Sz/x was computed for all samples and used as a measure of horizontal dispersion. Mean total crustacean density and dispersion approximated taxa density and dispersions. Tables and graphs are included.
W69-05302

BIOLOGICAL ASPECTS OF EUTROPHICATION IN LAKES MENDOTA, CRYSTAL, TROUT AND GREEN,
Wisconsin Univ., Madison. Lab. of Limnology,
A. D. Hasler, M. Terraguchi, and J. P. Wall.
Water Resources Center, Technical Completion Report, April 1969. 34 p, 6 tab, 3 fig, 21 ref, 2 append. OWRR Project A-002-WIS.

Descriptors: *Phytoplankton, Indicators, Trophic level, Cultures, *Eutrophication, Assay, *Zooplankton, Ecology, *Productivity.
Identifiers: Indicator organisms, Trophic potential.

This report is composed of two separate studies, the first concerning itself with an evaluation of the use of plankton organisms as bio-indicators of the trophic potential of a variety of Wisconsin lake types ranging from eutrophic to oligotrophic. Water samples and sediment extracts were innoculated with plankton species collected in the field and those cultured in the lab. A list of organisms used and relative success in culturing in various media is shown. Results of assay of extracts with Euglena gracilis and Aphanezomenon are presented. The second study is concerned with some physical, chemical and biological aspects of Green Lake, Wisconsin. Present data are described and then compared to past data on these aspects. Earlier and recent data on temperature and zooplankton are generally similar, whereas earlier and recent data on oxygen and phytoplankton show striking dissimilarities. Recent values of org.N and NH4-N are comparable to earlier values, whereas previous values of N03-N are higher than past ones by one order of magnitude. Several aspects of the ecology of Mysis relicta are described. (Bruins-Wis)
W69-05324

ARTIFICIAL MIXING OF DENSITY-STRATIFIED FLUIDS: A LABORATORY INVESTIGATION,
Princeton Univ., N. J. Lewis F. Moody Hydrodynamics Lab., and Princeton Univ., N. J. Dept. of Civil and Geological Engineering.
Lucien M. Brush, Francis C. McMichael, and Y. Kuo Chin.
N J Water Resources Res Inst Final Rep, No MH-R-2, Dec 1968. 80 p, 18 fig, 11 tab, 10 ref. OWRR Project: B-005-NJ.

Descriptors: *Reaeration, *Mixing, *Thermal stratification, *Reservoirs, Hypolimnion, Stagnant water, Water quality, Water quality control, Water pollution treatment, Diffusion, Turbulence, Pumping.
Identifiers: Destratification, Reservoir mixing, Air jet mixing.

Methods of artificially mixing a thermally or density-stratified reservoir are studied in models and the results extrapolated to reservoir scale. In small laboratory tanks propeller agitation is the best method and pumping the next best, but field studies showed no great differences in energy requirements between these methods and air jetting. Air jetting not only mixes water but also reaerates it, an important advantage if the hypolimnion is depleted in oxygen. Large scale convection and interfacial diffusion occur in mixing, and maximization of both is desirable. Jet discharges that disturb the density interface are preferable to those that do not. (Knapp-USGS)
W69-05412

SHOALING OF SOLITARY WAVES ON SMALL SLOPES,
Oregon State Univ., Corvallis. Dept. of Civil Engineering; and Stanford Univ., Calif. Dept. of Civil Engineering.
Frederick E. Camfield, and Robert L. Street.
ASCE Proc, J Waterways and Harbors Div, Vol 95, No WWI, Pap 6380, pp 1-22, Feb 1969. 22 p, 9 fig, append.

Descriptors: *Waves (Water), *Hydraulic models, Surf, Heights, Celerity, Seiches, Wave pile-up, Model studies, Mathematical models, Shoals.
Identifiers: Breaking waves, Shoaling waves, Solitary waves.

Solitary waves were used as initial wave shapes in model experiments to determine the criteria for shoaling wave growth, celerity, and breaking height. Theoretical methods of predicting wave breaking were reviewed and tested. None were found to be completely satisfactory. The commonly used criteria underestimate wave height. Empirical relations between wave dimensions, bottom geometry, wave growth, and form of breaking are derived, listed, and analyzed graphically. (Knapp-USGS)
W69-05450

RESERVOIR FISHERY RESOURCES,
American Fisheries Society, New York.
Charles, E. Lane, Jr.
Symp of Reservoir Fish Resources, Amer Fish Soc, Georgia Univ, Apr 5-7, 1967. 569 p, 142 fig, 3 map, 118 tab, 627 ref.

Descriptors: *Reservoir fisheries, *Fish management, Sport Fishing, Commercial fishing, Ecology, Environmental effects, Nutrient requirements, Water policy, Productivity, Reservoir operation, Water quality, Thermal stratification, Reaeration, Dissolved oxygen, Water pollution effects.
Identifiers: *Reservoir fishery management.

Reservoir fisheries are discussed in a symposium of 39 papers falling into the general themes of sport fish ecology, reservoir and fishery management, water quality effects, and reservoir design. Cooperation is needed between fishery biologists and project planning engineers to achieve better fishery conditions both in reservoirs and downstream waters. Prediction of water quality is possible with mathematical modeling of limnological and biological parameters used with careful dam design study. Principles of predator-prey relationships and other ecological relationships studied in other waters such as lakes and experimental ponds also apply to reservoirs. Management of fish populations is already practicable and with further research and development will be useful in meeting demand for reservoir fishing. Destratification is a relatively new field of research that shows promise for improving oxygen levels both in reservoirs and in water releases. (Knapp-USGS)
W69-05463

THE MECHANICS OF STRATIFIED FLOW IN RESERVOIRS,
Tennessee Valley Authority, Norris. Engineering Lab.
W. O. Wunderlich, and R. A. Elder.
Reservoir Fish Resources Symp, Georgia Univ, Apr 5-7, 1967, pp 56-68, 1967. 13 p, 6 fig, 12 ref.

Descriptors: *Reservoirs, *Stratification, Thermal stratification, Density stratification, Dissolved oxygen, Dye releases, Model studies.
Identifiers: Fontana Reservoir (TVA), Big Ridge Reservoir (TVA).

The phenomena leading to temperature stratification in reservoirs are discussed. A model is described for the approximate prediction of stratification and outflow water temperatures, based on theoretical principles and observed behavior of stratified flow in reservoirs. A similar model is proposed for predicting other water quality parameters, such as dissolved oxygen, if they are strongly influenced by stratification. An application of the method is shown in an example. The accuracy of the method is analyzed. (Knapp-USGS)
W69-05464

A LIMNOLOGICAL RECONNAISSANCE OF AN IMPOUNDMENT RECEIVING HEAVY METALS WITH EMPHASIS OF DIATOMS AND FISH,
Kansas Univ, Lawrence; and Academy of Natural Sciences of Philadelphia, Pa.
Richard Benoit, John Cairns, Jr., and Charles W. Reimer.
Reservoir Fish Resources Symp, Georgia Univ, Apr 5-7, 1967, pp 69-99, 1967. 31 p, 12 fig, 12 tab.

Descriptors: *Fishkill, *Water pollution effects, *Diatoms, *Acid mine water, Toxicity, Iron, Copper, California, Impounded waters, Tributaries.
Identifiers: Sacramento River (Cal), Keswick Lake (Cal), Lake Redding (Cal), Zinc.

Sporadic fishkills in the upper Sacramento River, California, below Keswick Reservoir were studied by attempting to locate and identify materials in the water that might be causing the problem. The upper tributaries of Keswick Lake had typical flora and fauna but Spring Creek, one of the lower tributaries, was severely degraded by acid mine drainage. A pulse of increased damage to diatoms in lower Keswick Lake and upper Lake Redding occurred during a freshet. Waters of Spring Creek Lake had very low pH and high concentrations of Fe, Cu, and Zn. The delta muds of Spring Creek in Keswick Lake had high concentrations of these metals. Both the Spring Creek water and the delta muds were toxic. At some times toxic conditions could develop in lower Keswick Lake and upper Lake Redding because of the acid water and heavy metals discharged from Spring Creek. (Knapp-USGS)
W69-05465

DYNAMICS OF PHYSICOCHEMISTRY IN A LARGE RESERVOIR,
Auburn Univ., Ala. Agricultural Experiment Station.
J. M. Lawrence.
Reservoir Fish Resources Symp, Georgia Univ, Apr 5-7, 1967, pp 100-113, 1967. 14 p, 6 fig.

Descriptors: *Reservoirs, *Density currents, *Stratification, *Chemistry, *Water quality, Tracers, Dye releases, Georgia, Impoundments, Sampling.
Identifiers: *Physicochemistry, Lake Eufaula (Ga), Walter F. George Reservoir (Ga).

Thermal and chemical stratification occurred in all inundated areas of Walter F. George Reservoir, Georgia, during summer months of 1965 and 1966, but was broken at least four times each year by cool-rainy weather. Dye studies indicated existence of main channel density currents during stratified conditions. Iron concentrations in water varied

with stratification and often appeared to be in particle form. Calcium plus magnesium contents of these waters averaged 5.5 ppm, which places this lake in the very soft water category. Total carbon content averaged 13 ppm in 1965 and 11 ppm in 1966. (Knapp-USGS)
W69-05466

WATER QUALITY IN IMPOUNDMENTS AND MODIFICATIONS FROM DESTRATIFICATION,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Cincinnati Water Research Lab.
William H. Irwin, James M. Symons, and Gordon G. Robeck.
Reservoir Fish Resources Symp, Georgia Univ, Apr 5-7, 1967, pp 130-152, 1967. 23 p, 18 fig, 2 tab.

Descriptors: *Stratification, *Impoundments, *Water quality, *Reservoirs, *Dissolved oxygen, *Anaerobic conditions, *Reaeration, Mixing, Kentucky, Thermal stratification.
Identifiers: Artificial destratification.

The success of projects to regulate streamflow for improving water quality depends on a source of good quality impounded water that can be used for downstream flow control. Engineering methods to overcome or prevent water quality deterioration that occurs during storage are being investigated. Some of the reactions that take place in reservoirs and lakes are described and are presented to demonstrate the effectiveness of artificial destratification as a means of maintaining good quality water. In thermally stratified impounded water, the lower waters in the impoundment are effectively sealed from the atmosphere by the warm water floating on the surface. Because atmospheric reaeration is prevented, the naturally occurring oxygen-demanding reactions reduce the dissolved oxygen concentration to zero, and reducing reactions such as sulfide production with iron and managanese dissolution can degrade water quality. Because very little energy is required per unit volume to lift the cooler water to the surface of a stratified impoundment, an attempt was made to artificially destratify 2 small lakes in northern Kentucky, one 2,000 acre-ft and the other 4,600 acre-ft. In 1965, a raft-mounted pump was used, while in 1966, a diffused air system was used. Considerable improvement in water quality resulted from the mixing. Nearly uniform water temperatures, better vertical distribution of the DO, decreases in the concentration of reduced materials, and prevention of reduction reactions from continuing all resulted from the destratification operation. These improvements in the quality of the water made it a better source of streamflow regulation and improved its recreational potential. (Knapp-USGS)
W69-05467

EVALUATION OF PRE-IMPOUNDMENT CONDITIONS FOR PREDICTION OF STORED WATER QUALITY,
Federal Water Pollution Control Administration, Corvallis, Oreg. Pacific Northwest Water Lab.
Lyman H. Nielson.
Reservoir Fish Resources Symp, Georgia Univ, Apr 5-7, 1967, pp 153-168, 1967. 16 p, 5 fig, 2 tab, 41 ref.

Descriptors: *Reservoirs, *Water quality, *Forecasting, Nutrients, Dissolved oxygen, Water temperature, Mathematical models, Impounded waters, Photosynthesis.
Identifiers: Water quality prediction.

Methods for forecasting water temperature and dissolved oxygen in new reservoirs are outlined. Use of a mathematical model is suggested to predict photosynthesis as a function of water temperature, available light energy, light transmissibility through the water mass, and nutrient concentration. Thermal budget methods are proposed for temperature prediction. Aerial photographs may be used to calculate vegetation to be submerged. Total nutrient input to new reservoirs is used to estimate algal growth. (Knapp-USGS)
W69-05468

EFFECT OF IMPOUNDMENTS ON PRODUCTIVITY, WATER CHEMISTRY, AND HEAT BUDGETS OF RIVERS,
Montana State Univ., Bozeman. Dept. of Botany and Microbiology.
John C. Wright.
Reservoir Fish Resources Symp, Georgia Univ, Apr 5-7, 1967, pp 188-199, 1967. 12 p, 2 fig, 3 tab, 32 ref.

Descriptors: *Reservoirs, *Water quality, *Hypolimnion, Stratification, Reservoir operation, Fish management, Productivity, Heat budget, Eutrophication, Zooplankton.
Identifiers: Hypolimnial water releases.

The practice of designing large deep multiple-purpose dams with deep-water penstocks appears to have many deleterious effects. Water is released during the irrigation season with a higher salinity than would be obtained from surface water withdrawal. Essential nutrients are lost from such reservoirs, thus tending to deplete the productive capacity of the reservoir and at the same time cause eutrophication downstream. Evaporative loss is increased as a result of storing warm incoming water and releasing cold hypolimnial water. Water too cold for satisfactory fish growth may also be released under certain conditions. Water with dissolved oxygen concentrations too low to handle downstream BOD may be released. In extreme cases hydrogen sulfide-laden water has been discharged resulting in downstream fish-kills. The interrelationships between fish populations and zooplankton production in reservoirs should be more carefully investigated. Since bottom fauna production is usually negligible in such reservoirs, excessive predation pressure on large zooplankton forms by fish may be responsible, in part, for decreased fish production. (Knapp-USGS)
W69-05469

RESERVOIR MANAGEMENT PROBLEMS CREATED BY INCREASED PHOSPHORUS LEVELS OF SURFACE WATERS,
Southern Illinois Univ., Carbondale. Dept. of Botany.
Jacob Verduin.
Reservoir Fish Resources Symp, Georgia Univ, Apr 5-7, 1967, pp 200-206, 1967. 7 p, 1 fig, 3 tab, 15 ref.

Descriptors: *Reservoir operation, *Eutrophication, *Phosphorus, Lake Erie, Algae, Sewage treatment, Tertiary treatment, Nutrients, Nitrogen, Lagoons.
Identifiers: Reservoir management, Phosphorus removal.

Phosphorus levels have increased in fresh waters of the U.S.A. about four-fold during the past 20 years. Present levels are in the vicinity of 100-200 micrograms/liter, and are about 10 times higher than the levels considered sufficient to produce nuisance concentrations of algae. Nitrogen to phosphorus ratios have dropped from values of 35 to about 9, in Lake Erie, indicating a more nearly balanced N:P supply. High nutrient levels are likely to create such increased problems for reservoir management as foul odors and tastes in drinking water, large deposits of algae on beaches, and fish and benthos mortality. It is suggested that lagoons be constructed as an adjunct to sewage treatment plants to reduce nutrient levels by natural cropping before releasing sewage effluents to our streams and lakes. (Knapp-USGS)
W69-05470

RESERVOIR EUTROPHICATION AND DYSTROPHICATION FOLLOWING IMPOUNDMENT,
North Dakota Univ., Grand Forks. Dept. of Biology.
Joe Kendall Neal.
Reservoir Fish Resources Symp, Georgia Univ, Apr 5-7, 1967, pp 322-332, 1967. 11 p, 1 fig, 2 tab.

Descriptors: *Reservoirs, *Eutrophication, *Dystrophy, Water quality, Productivity, Nutrients, Missouri River, Plankton, Phosphorus, Nitrogen.
Identifiers: Missouri River Reservoirs.

Commonly accepted concepts of productivity controls in inland waters are reviewed and their modifications by reservoirs discussed. Various factors contributing to early reservoir enrichment and productivity decline are related to reservoir characters and peculiarities. Type and size of reservoir, initial operation, pretreatment of basin, nature of inundated soils, withdrawal of bottom waters, and isolation of flow segments are included. Factors associated with early autotrophic maxima and minima in Missouri River main stem reservoirs indicate that phosphorus and nitrogen build-up was prerequisite to maximum growth, but that exhaustion of other nutrients led to decline after nitrogen and phosphorus ceased to be limiting factors. Phosphorus and nitrogen concentration increased with plankton declines and decreased with plankton growth. During early impoundment, plankton often reached greater densities below reservoirs than in them. (Knapp-USGS)
W69-05471

WATER RESOURCES LAW IN VIRGINIA (ARTIFICALLY CONFINED WATER).
William R. Walker, and William E. Cox.
Water Resources Law in Virginia, Bulletin 9, Aug 1968, 181 p, 412 ref, 1 fig.

Descriptors: *Virginia, *Water sources, *Water rights, *Confined water, Riparian rights, Publications, Water law, Legal aspects, Ponds, Lakes, Channels, Drains, Drainage, Soil conservation, Water works, Sewage systems, Local governments, Regulation.

The law applicable to artificially confined water differs from that applicable to water in its natural state. The extent of this difference is dependent upon the nature of the artificial confinement. Legal rights associated with ponds and artificial lakes are determined by the source of the impounded water. When the source is a natural watercourse, the law applicable to the rights in the watercourse governs; if the source is diffused surface water, then the law applicable to that type of water controls. No riparian rights attach to water in a canal, and the only rights which have been recognized are those based on contracts and franchises. Supervision and control of all waterworks in the state and all waters therein is exercised by the State Board of Health. All sewerage systems are under the joint supervision of the State Department of Health and the State Water Control Board. Two basic remedies for the infringement of water rights are actions at law for damages and actions in equity for injunctions. The statute of limitations in Virginia is five years. It begins to run at the time the cause of action accrues, which is the time the injury actually occurs. There is a duty to mitigate damages by the exercise of ordinary care. (Childs-Fla)
W69-05537

2I. Water in Plants

EFFECTS OF MOISTURE AND FERTILIZER ON YIELDS OF SPRING WHEAT AND BARLEY,
Nevada Univ., Reno; Cornell Univ., Ithaca, N. Y.
A. Bauer, R. A. Young, and J. L. Ozbun.
Agronomy J, Vol 57, No 4, pp 354-356, July-Aug, 1965. 4 tab, 10 ref.

Descriptors: *Rainfall, *Wheat, *Barley, *Crop response, *Nitrogen, Soil moisture, Planting management, Crop production, Fertilizers, Seasonal, Spring, North Dakota, Rates of application, Moisture availability, Correlation analysis.
Identifiers: Parameters.

Investigations were conducted in North Dakota to evaluate effects of seasonal rainfall and stored available soil moisture at seeding on yield responses of spring-sown wheat and barley with varying

rates of applied nitrogen. Average grain yields increased as rainfall increased, both with and without fertilizers. The magnitude of response as well as the rate of nitrogen fertilizer needed for maximum yield also increased as rainfall increased. With more stored available soil moisture at seeding, less seasonal rainfall was required to produce profitable responses to nitrogen. Highly significant correlation coefficients were obtained between selected yield parameters and moisture categories under the arid growing conditions. (Blecker-Ariz)
W69-05263

DROUGHT AND PHOSPHORUS AFFECT GROWTH OF ANNUAL FORAGE LEGUMES,
Agricultural Research Service, Pullman, Wash. Research Div.; California Univ., Riverside; California Univ., Davis.
A. M. Wilson, C. M. McKell, and W. A. Williams.

J of Range Management, Vol 21, No 5, pp 305-308, September 1968. 2 fig, 6 tab, 8 ref.

Descriptors: *Legumes, *Drought resistance, *Phosphorus, *Moisture stress, *Water utilization, Clovers, Root systems, Photosynthesis, Transpiration, Annual, Forage legumes, Growth stages, Fertilizers, Plant growth, Crop response, California, Semiarid climates, Soil moisture, Absorption.

A study was conducted to understand drought resistance in 3 annual legumes and to determine the role that phosphorus might play in their response to soil moisture stress. The legumes were Mt Barker subterranean clover, rose clover and Spanish clover. Spanish clover was lowest and subterranean clover was highest in top growth production in the 1 atm regime. In the 3 and 15 atm regimes, top growth of the 3 annual legumes did not differ significantly. Growth of Spanish clover was inhibited less by moderate stress than growth of rose and subterranean clover. The pattern of root growth response to moisture stress for all legumes was essentially similar. Efficient water use by fertilized annual legumes suggested that phosphorus increased photosynthesis per unit leaf area more than transpiration per unit leaf area. Stimulation of growth by phosphorus fertilization in drier regimes did not necessarily mean that phosphorus enhanced drought resistance of annual legumes. Top growth and phosphorus uptake, on a relative basis, suggest that Spanish clover possessed greater drought resistance than rose and subterranean clover. (Blecker-Ariz)
W69-05264

EFFECT OF MOISTURE REGIMES AND HARVESTS ON EFFICIENCY OF WATER USE BY TEN FORAGE CROPS,
Pennsylvania State Univ., University Park.
R. D. Powell, and L. T. Kardos.
Soil Sci Soc Amer Proc, Vol 32, No 6, pp 871-874, Nov-Dec, 1968. 6 tab, 10 ref.

Descriptors: *Soil water, *Moisture deficit, *Forage grasses, *Forage legumes, *Harvesting, Water utilization, Consumptive use, Irrigation efficiency, Hay, Soil-water-plant relationships, Water requirements, Rates of application, Crop production, Pastures, Meteorological data, Bouyoucos blocks.
Identifiers: *Blaney-Criddle formula, Dry matter.

Total amounts and rates of depletion of soil water required to produce dry matter by 10 crops were studied. Water use efficiency of forages managed as either hay or simulated pasture under three levels of irrigation was also studied. On the basis of total harvest for all species, most efficient use of water occurred at the control irrigation level. Most efficient use of water occurred prior to the first harvest and least efficient use usually occurred after the first harvest but prior to the second harvest. Alfalfa swards managed for hay were more efficient than other swards and legume-grass combinations differed only slightly from legumes alone. Measured values for rates of moisture depletion per day of all unirrigated forages were generally smaller than values computed by using the Blaney-Criddle formula. Measured values of irrigated forages approached the Blaney-Criddle values more closely. By using correct forage crops and irrigation levels, efficiency of water use by plants could probably be increased in arid climates. (Blecker-Ariz)
W69-05268

STOMATAL OPENING IN ISOLATED EPIDERMAL STRIPS OF VICIA FABA. I. RESPONSE TO LIGHT AND TO CO2-FREE AIR,
California Univ., Davis. Lab. of Plant-Water Relations.
R. A. Fischer.
Plant Physiol, Vol 43, No 12, pp 1947-1952, 1968. 1 fig 4 tab, 22 ref.

Descriptors: *Stomata, *Epidermis, *Air, *Carbon dioxide, *Light, Leaves, Cytological studies, Plant physiology, Crop response, Absorption, Beans, Osomotic pressure, Turgidity.
Identifiers: Mesophyll, Starch.

This paper reports a consistent and large opening response to light and CO sub 2-free air in living stomata of isolated epidermal strips of Vicia faba. The response was compared to that of non-isolated stomata in leaf discs floating on water; stomatal apertures, guard cell solute potentials and starch contents were similar in the 2 situations. It was necessary to float epidermal strips on dilute KCL solutions to obtain such stomatal behavior. This suggested that solute uptake was necessary for stomatal opening. This technique provides a very useful system in which to investigate the mechanism of stomatal opening. It was possible to show independent responses in stomatal aperture to light and to CO sub 2-free air. (Affleck-Ariz)
W69-05278

EFFECT OF EARLY-SUMMER SEEDING OF WINTER WHEAT ON YIELD, SOIL MOISTURE, AND SOIL NITRATE,
Utah State Univ., Logan. Dept. of Plant Science.
For primary bibliographic entry see Field 03F.
W69-05280

TISSUE WATER RELATIONS FOR BRIGALOW AND MULGA,
Queensland Univ., Brisbane (Australia). Dept. of Botany.
D. J. Connor, and B. R. Tunstall.
Aust J Bot, Vol 16, pp 487-490, 1968. 1 fig, 15 ref.

Descriptors: *Plant tissues, *Moisture content, *Drought resistance, *Leaves, Drought tolerance, Arid climates, Plant physiology, Resistance, Turgidity.
Identifiers: *Mulga, *Brigalow, *Australia, *Phyllodes, Water potential, Microdesiccators, Desiccation.

The relationship between relative water content and water potential of leaves measures the amount of water held by leaf tissues at various levels of water potential. This is more commonly termed the resistance of leaf tissue to desiccation and is taken to indicate one aspect of drought resistance of the species involved. The species with the smaller change in relative water content for each interval of water potential is considered to be the more drought resistant. In this study the relationship between relative water content and water potential of the phyllodes in brigalow and mulga were compared. Brigalow phyllode tissue was found to be more resistant to desiccation than that of mulga. This was of interest because mulga has previously been considered to represent an extreme in drought tolerance of Australian arid zone plants. (Affleck-Ariz)
W69-05281

RELATIONSHIP OF PALMER DROUGHT VARIABLES TO YIELD OF WINTER WHEAT,
Kansas State Univ., Manhattan; Weather Bureau, Silver Spring, Md.
For primary bibliographic entry see Field 03F.
W69-05283

ISOPIESTIC TECHNIQUE FOR MEASURING LEAF WATER POTENTIALS WITH A THERMOCOUPLE PSYCHROMETER,
Duke Univ., Durham, N. C. Dept. of Botany.
John S. Boyer, and Edward B. Knipling.
Proc National Academy Science, Vol 54, No 4, pp 1044-1051, October 1965. 3 fig, 2 tab.

Descriptors: *Plant tissues, *Hygrometry, *Water vapor, *Leaves, *Measurement, Equations, Moisture stress, Instrumentation, Evaporation, Cooling, Diffusion, Resistance.
Identifiers: *Water potential, *Thermocouple, *Isopiestic, Error.

A new technique of measuring water potential of plant tissue was developed. This technique, which was free of error usually attributable to leaf resistance, was used to evaluate error in various types of psychrometers. The new technique involved use of a modified Richards thermocouple to determine rate of vapor movement between the thermocouple and leaf when solutions of various potentials were present on the thermocouple. No vapor movement occured when solution on the thermocouple had a potential equal to that of the tissue and therefore leaf resistance did not affect measurement. The theoretical basis for this conclusion was developed using equations. It was possible to determine the influence of leaf resistance on various thermocouple measurements for leaf tissue from several plant species at various water potential levels. The thermocouple psychrometer can be used to measure water potential levels of leaves in order to determine moisture stress that plants undergo when they are grown in an arid climate. (Blecker-Ariz)
W69-05286

SEASONAL AND DIURNAL VARIATION IN POCOSIN SHRUB MOISTURE CONTENT,
Forest Service (USDA), Asheville, N. C. Southeastern Forest Experiment Station; Forest Service (USDA), Macon, Ga. Southern Forest Fire Lab.; North Carolina Div. of Forestry.
W. H. Blackmarr, and William B. Flanner.
Forest Service, USDA, Research Paper SE-33, pp 1-11, Apr 1968. 11 p, 1 fig, 12 chart.

Descriptors: *Moisture content, Plant physiology, *Diurnal, *Seasonal, Spring, Summer, Autumn, *Leaves, *Stemflow, Shrubs.
Identifiers: *Pocosin.

Seasonal variation in the moisture content of six species of pocosin shrubs was observed over a 10-month period during 1965. The variation in the moisture content of the foliage and stems is compared with the average moisture content of the whole plant. Moisture contents of both stems and foliage reached their lowest levels during the fall and early spring. The moisture content of most species increased rapidly through May, reaching a maximum during the first 2 weeks of June. The initiation of new foliage occurred at about the same time that the average moisture content of the whole plant began its rapid spring buildup. Diurnal variation in the moisture content of the foliage of four shrub species was observed over a 36-hour period during June 21 and 22, 1965. The moisture content of newly developed foliage exhibited noticeable diurnal fluctuation. Maximum moisture contents occurred between 2 and 6 a.m. Minimum moisture contents occurred between 2 and 6 p.m.
W69-05331

COMMON AQUATIC WEEDS,
Agricultural Research Service, Gainesville, Fla. Crops Research Div.; and Florida Univ., Gainesville. Agricultural Extension Service.

L. W. Weldon, R. D. Blackburn, and D. S. Harrison.
Dep Agr Res Serv Handbook No. 352, Jan 1969. 43 p, 49 fig, 20 ref.

Descriptors: *Aquatic plants, Aquatic algae, Aquatic weeds, Floating plants, Pondweeds, Rooted aquatic plants, Submerged plants.
Identifiers: Aquatic plant identification handbook, Plant redognition.

A handbook for field identification of common aquatic weeds is presented. Photographs of the plants are used to aid in identification, and where necessary, the important characteristics of the plants are emphasized by drawings. Plant descriptions, habitats, distribution, and importance are listed. The plants are classified in 5 groups: Free-floating plants; aquatic grasses; emersed plants; submersed plants; and algae. Plants which closely resemble each other are described together for easier differentiation. (Knapp-USGS)
W69-05446

2J. Erosion and Sedimentation

GRANITES, GRUSSES, AND THE SHERMAN EROSION SURFACE, SOUTHERN LARAMIE RANGE, COLORADO-WYOMING,
Pennsylvania State Univ., University Park; Colorado Univ., Boulder.
D. H. Eggler, E. E. Larson, and W. C. Bradley.
Amer J of Sci, Vol 267, pp 510-522, Apr 1969. 13 p, 3 fig, 2 tab, 1 plate, 26 ref.

Descriptors: *Topography, *Erosion, *Weathering, *Granites, Geomorphology, Land forming, Petrography, Mapping, Colorado, Wyoming, Oxidation, Clay minerals.
Identifiers: *Grusses, Southern Laramie Range.

Recent detailed mapping of the southern Laramie Range in Wyoming-Colorado reveals that the smooth Sherman erosion surface is closely related to bedrock lithology of the Precambrian Trail Creek part of the Sherman Granite. Other crystalline rocks form a rugged, parkland-tor topography. A distinctive petrographic characteristic of the Trail Creek is extensive oxidation with principally opaque and biotite minerals. Weathering has exploited the oxidized biotites to produce vermiculite, montmorillonite, kaolinite, and gibbsite, all contributing to additional biotite expansion and shattering the near-surface rock. Gruss is formed so rapidly that rugged outcrops are few and a smooth gently rolling topography results. (Lang-USGS)
W69-05211

VARIABLE-SPEED POWER EQUIPMENT FOR DEPTH-INTEGRATION SEDIMENT SAMPLING,
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 07B.
W69-05257

ELECTRIC CONTROL SYSTEM FOR DUAL OPERATION OF CURRENT METER AND SUSPENDED-SEDIMENT SAMPLER,
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 07B.
W69-05258

FLAT CHANNEL TERRACES,
Soil Conservation Service, McCook, Nebr.
H. G. Buchta, D. E. Broberg, and F. E. Liggett.
Trans American Soc Ag Engineers, Vol 9, No 4, pp 571-573, 1966. 4 fig, 2 tab, 5 ref.

Descriptors: *Terracing, *Erosion control, *Flood control, *Runoff, *Channels, Surface runoff, Storms, Storage capacity, Sediments, Storm runoff, Slopes, Water storage, Water conservation, Floodwater, Kansas, Nebraska.

Level terraces with blocked ends have been used for erosion control. They are designed to hold runoff from storms in the 10-year frequency class in Nebraska and Kansas. Flat-channel terraces have held the runoff from high intensity storms of 4 to 6 inches with little or no damage. The cost of providing cropland flood storage compares favorably, on slopes to 4%. Storage capacity for both floodwater and sediment may be substantially reduced for mechanical structures located below areas treated with flat channel terraces. The terraces could possibly be used in arid climates to control sediment and runoff water. (Blecker-Ariz)
W69-05282

PREDICTION OF SEDIMENT PROFILES IN OPEN CHANNEL FLOW BY TURBULENT DIFFUSION THEORY,
Kentucky Univ., Lexington; and Texas A and M Univ., College Station. Water Resources Inst.
Billy J. Barfield, Ernest T. Smerdon, and Edward A. Hiler.
Water Resources Res, Vol 5, No 1, pp 291-299, Feb 1969. 10 p, 6 fig, 10 ref. WP-00757-03 (FWP-CA).

Descriptors: *Sediment transport, *Suspended load, Open channel flow, *Mathematical models, *Hydraulic models, Probability, Model studies, Sedimentation, Roughness (Hydraulic), Turbulence, Dispersion, Velocity, Settling velocity.
Identifiers: *Sediment profiles, Particle fall velocity.

Using turbulent diffusion theory, a non-steady-state model of sediment transportation is developed in the form of a partial differential equation relating the change of sediment concentration with time to the change of concentration in space. The required input to the model is the root-mean-square fluid velocity, the time scale of turbulence, and the mean particle fall velocity. Preliminary experimental investigations are reported using turbulence measurements made over a smooth channel. When smooth channel turbulent intensities were used, predicted sediment concentrations were low when compared with actual measurements. When turbulent intensities were used from an artificially roughened channel, the predicted concentrations were of the same order as the measured concentrations. Since data were not available for turbulent intensities in alluvial channels, no conclusion could be made about the validity of the model. (Knapp-USGS)
W69-05403

RELATION OF SOIL PROPERTIES TO ITS ERODIBILITY,
Agricultural Research Service, Lafayette, Ind.; and Purdue Univ., Lafayette, Ind. Dept. of Agronomy.
W. H. Wischmeier, and J. V. Mannering.
Soil Sci Soc Amer Proc, Vol 33, No 1, pp 131-137, Jan-Feb 1969. 7 p, 1 fig, 4 tab, 17 ref.

Descriptors: *Soil erosion, *Runoff, *Soil physical properties, Soil conservation, Erosion control, Soil stability, Soil strength, Bulk density, Particle size, Soil structure, Soil aggregates, Permeability, Porosity, Soil texture, Saturation, Sands, Silts, Clays, Organic matter, Hydrogen ion concentration, Crops, Grasses, Slopes.
Identifiers: Soil-loss prediction, Soil erodibility, Soil detachment.

A soil's inherent erodibility, which is a major factor in erosion prediction and land-use planning, is a complex property dependent both on its infiltration capacity and on its capacity to resist detachment and transport by rainfall and runoff. The relations of these capacities to soil physical and chemical properties were investigated in a 5-year field, laboratory, and statistical study including 55 selected Corn Belt soils. Properties that contributed significantly to soil-loss variance included percentages of sand, silt, clay, and organic matter; pH, structure and bulk density of plow layer and subsoil; steepness and concavity or convexity of slope; pore space filled by air; residual effects of sod crops; aggregation; parent material; and various interactions of these variables. An empirical equation was derived for calculating the universal soil-loss equation's erobility factor K for specific soils. Tests of the equation against soils of the older erosion-research stations, for which the erodibility factor is known, substantiated its general applicability over a broad range of medium-textured soils. (Knapp-USGS)
W69-05444

SHOALING OF SOLITARY WAVES ON SMALL SLOPES,
Oregon State Univ., Corvallis. Dept. of Civil Engineering; and Stanford Univ., Calif. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02H.
W69-05450

2K. Chemical Processes

VARIATION IN THE COMPOSITION OF BRINE FROM THE SYLVANIA FORMATION NEAR MIDLAND, MICHIGAN,
Dow Chemical Co., Midland, Mich.
For primary bibliographic entry see Field 02F.
W69-05401

DYNAMICS OF PHYSICOCHEMISTRY IN A LARGE RESERVOIR,
Auburn Univ., Ala. Agricultural Experiment Station.
For primary bibliographic entry see Field 02H.
W69-05466

2L. Estuaries

ON THE REPRESENTATION OF THE REYNOLDS STRESS IN A TIDAL ESTUARY,
Reading Univ. (England). Dept. of Geophysics.
B. Johns.
Geophys J Roy Astron Soc, Vol 17, No 1, pp 39-44, Jan 1969. 6 p, 1 fig, 4 ref.

Descriptors: *Estuaries, *Tides, *Turbulence, Currents (Water), Reynolds number, Viscosity, Tidal effects.
Identifiers: Eddy viscosity, Reynolds stress.

The parametric representation of turbulence by a coefficient of eddy viscosity is discussed for the tidal flow in a river estuary. If the eddy viscosity attains a specified maximum value in the mid-depths, it is shown that the amplitude of the tidal current has a logarithmic profile throughout the depth. (Knapp-USGS)
W69-05213

THE LONGITUDINAL DIFFUSION COEFFICIENT IN THE DELAWARE RIVER ESTUARY AS DETERMINED FROM A STEADY-STATE MODEL,
Geological Survey, Philadelphia, Pa.
Richard W. Paulson.
Water Resources Res, Vol 5, No 1, pp 59-67, Feb 1969. 9 p, 7 fig, 3 tab, 6 ref.

Descriptors: *Diffusion, *Estuaries, *Path of pollutants, Model studies, Dispersion, Diffusivity, Water quality, Saline water-freshwater interfaces, Salinity, Mathematical models, Computer models, Digital computers.
Identifiers: *Delaware estuary.

An analytical solution to 1-dimensional steady-state diffusion of a conservative substance in an estuary of constant depth and exponentially varying width is derived using a turbulent diffusion coefficient which varies exponentially with estuary width. Because the form of the diffusion coefficient allows 2 deg of freedom in fitting the solution of the diffusion equation to data from a real estuary, it is

possible to determine the magnitude of the diffusion coefficient as well as the effect on the distribution of the conservative substance of assuming a constant coefficient. Data from the reach of the Delaware estuary from Torresdale, Pa. to Reddy Island, Del. were used to test the solution, because fresh-water inflow data are available for the reach, and its channel geometry satisfies the above requirement. This reach also contains 5 U.S. Geological Survey water-quality monitors that provide salinity data to test the solution. Analysis of these data indicates that, for low freshwater inflow into the estuary, the diffusion constant is of the order of 100 m squared per second and that for most operational purposes the diffusion constant may be assumed to be a constant. (Knapp-USGS)
W69-05428

EQUILIBRIUM FLOW AREAS OF INLETS ON SANDY COASTS,
California Univ., Berkeley. Coll. of Engineering.
Morrough P. O'Brien.
ASCE Proc, J Waterways and Harbors Div, Vol 95, No WWI, Pap 6405, pp 43-52, Feb 1969. 10 p, 3 fig, 1 tab, 2 ref, append.

Descriptors: *Harbors, *Currents (Water), Estuaries, Tides, Waves (Water), Beaches, Sands, Sand bars, Sedimentation, Breakwaters, Coasts, Jetties, Coastal engineering, Tidal effects.
Identifiers: Tidal currents (Inlets), Tidal prism.

The minimum flow area below mean sea level in the entrance channel of a tidal inlet on a sandy coast is a unique function of the tidal prism. Bottom material size, presence or absence of jetties, and magnitude of the littoral drift appear not to affect this relationship, within the accuracy of available data. The magnitude of the currents through the inlet channel are determined by the range of tide. The tendency for wave-induced littoral currents to transport sand towards an inlet and to reduce its flow area should vary with the intensity of wave action, but the data available do not show wide deviations from the equilibrium area, possibly because hydrographic surveys are made during calm weather. Reduction in the tidal prism of an inlet will reduce the equilibrium flow area at the minimum cross section of the inlet channel. (Knapp-USGS)
W69-05447

WATER WAVES OVER A RECTANGULAR CHANNEL THROUGH A REEF,
Suez Canal Authority Research Center, Ismailia (Egypt).
Nabil Hilaly.
ASCE Proc, J Waterways and Harbors Div, Vol 95, No WWI, Pap 6409, pp 77-94, Feb 1969. 18 p, 20 fig, 9 ref, append. Corps of Eng DA-49-055-CIVENG-63-5.

Descriptors: *Waves (Water), *Channels, *Refraction (Water waves), Reefs, Hydraulic models, Model studies, Mathematical models, Ripple marks.
Identifiers: Ripple tank studies, Diffraction (Water waves), Reef channels.

A practical method for predicting characteristics of waves propagating over a submarine channel, of rectangular cross section is presented, based on experimental results and theoretical models. The ripple tank was a useful tool in wave refraction studies. In the case when waves propagate over an abrupt bottom discontinuity normal to their crests, the adjacent wave fronts in both sides of the discontinuity were connected by smooth transitions, 2 straight lines could be drawn, inclined to the discontinuity, to define the transition zones, and the angles between the discontinuity and the 2 straight lines defining the transition zones in the deep and shallow sides were not constant. They vary with the ratio (height/length--shallow)/(height/length--deep). (Knapp-USGS)
W69-05448

WATER SUPPLY IN THE BRACKISH-WATER REGIONS OF SOUTH VIETNAM.
Ministry of Public Works (South Vietnam).

For the 8 Volume Proceedings, see Vol 2, No 9, Field 06B and W69-03305. Int Conf on Water for Peace, Wash, D C, Vol 2, pp 876-880, 1968. 5 p, 2 fig, 1 tab.

Descriptors: *Water resources development, *Brackish water, *Groundwater, *Saline water intrusion, Water supply, Water wells, Desalination, Alluvium, Deltas, Water utilization, Water yield.
Identifiers: Viet-Nam, Mekong delta.

The South Viet-Nam delta is a very low and flat region averaging 1 to 2 meters above sea level. Sea water intrudes inland 70 km. The water in the rivers and canals and in the phreatic water table is brackish everywhere. A total of 3 million people (30% of the delta population) suffer greatly from the shortage of potable water during the dry season (November to May). Rain water stored in cisterns, water brought in by boat from neighboring regions, small fresh-water pockets located at a depth of 1 to 3 m are not a true solution to this serious problem. The region contaminated by sea water has an unconsolidated aquifer, the Recent alluviums, made up of sand, silt, clay, and very little gravel. A fresh-water stratum, whose thickness may range from a few meters to 10 m, is 200 to 300 m deep. Except in the provinces located between the 2 branches of the Mekong, where wells drilled as deep as 300 m have not yet yielded any satisfactory results, the chances of success in the search for fresh-water-bearing strata vary from 80 to 100%. A well with a capacity of 100 cu m per hr, drilled 200 m deep, costs $18,000 (a surface-water treatment plant with the same capacity costs $80,000). As the operation is very simple (the well water being directly consumable, without treatment) the cost is only 3 cents per cu m (6 cents per cu m in a treatment plant). A well can be completed in 4 months; the construction of a plant takes 18 months. If the electrodialysis process is contemplated, although it is the best method for the desalination of brackish water, the construction cost will be 40 times higher and the operating cost 8 times higher. (Knapp-USGS)
W69-05457

SALT WATER ENCROACHMENT IN KARST AQUIFERS, ISLAND OF KEPHALLINIA, (IONIAN),
Society of Hydrogeological Scientists Graz, (Austria).
V. Mourin, and J. Zoetl.
Hydrol of fractured rocks Vol 2, Proc Dubrovnik Symp (Oct 1965), Int Ass Sci Hydrol, Pub 74, pp 423-438, 1967. 16 p, 8 fig, 3 tab, 10 ref.

Descriptors: *Saline water intrusion, *Karst, *Saline water-fresh water interfaces, Groundwater movement, Sea level, Water levels, Infiltration, Hydrogeology, Precipitation (Atmospheric), Aquifers, Water circulation, Carbonate rocks, Structural geology, Water temperature, Springs, Water chemistry.
Identifiers: *Greece, Kephallinia Island, Ionian Sea.

The reappearance of salt water that disappears into the rocks of Kephallinia Island was investigated using hydrogeological methods. One method used was the dissolving of 160 kg of fluorescein in the groundwater at an observation station and its identification as a coloring substance, in the brackish water springs of the eastern coast, which is 15 km distant. Surveys included appraisals and mapping of 243 springs and wells. The study shows that during the Pleistocene age an aquifer, existing in the present Gulf of Livadi, was drained subterraneously towards the lower level of the eastern coast. In general, the fresh waters issuing from the main massif to the east and the old, lower-levelled karstic holes that allow inflow of sea water into the rock fissures of the northern part of the peninsula, are the most important factors of the hydrological processes taking place in the Kephallinia Island. (Gabriel-USGS)
W69-05472

SALT-WATER ENCROACHMENT OF TERTIARY LIMESTONE ALONG COASTAL SOUTH CAROLINA,
Geological Survey, Columbia, S. C.
George E. Siple.
Hydrol of fractured rocks Vol 2, Proc Dubrovnik Symp (Oct 1965), Int Ass Sci Hydrol, Pub 74, pp 439-453, 1967. 15 p, 6 fig, 16 ref.

Descriptors: *Saline water intrusion, *Limestones, *Geology, *Saline water-fresh water interface, *South Carolina, Aquifers, Stratigraphy, Structural geology, Water circulation, Hydraulic gradient, Infiltration, Tertiary, Permeability, Sediment distribution, Sea water, Geochemistry, Sea level, Artesian wells.
Identifiers: Salt-water encroachment.

Limestones and clastic sediments of coastal South Carolina, characterized by their high-grade aquifers, have been invaded during Recent and past geologic epochs by sea water. To understand the magnitude of this encroachment, the author conducted a detailed investigation by means of geological, hydrological and geochemical methods. The study shows that the upper zones of Eocene limestones, incised by estuaries during Pleistocene and Recent time, and the sub-sea contact of Eocene and Oligocene deposits are now subject to considerable salt-water encroachment. The most extensive encroachment occurs in the limestones of Tertiary age and clastic beds of Cretaceous age. The aquifers located in these beds have fresh-water heads ranging from altitudes of -3m to +49m and maximum chloride concentration of about 8,500 ppm. (Gabriel-USGS)
W69-05473

A CONTINUOUS SIZE SPECTRUM FOR PARTICULATE MATTER IN THE SEA,
Fisheries Research Board, Nanaimo (British Columbia). Pacific Oceanographic Group.
For primary bibliographic entry see Field 07C.
W69-05529

WATER RESOURCES LAW IN VIRGINIA (OTHER WATER SOURCES).
For primary bibliographic entry see Field 06E.
W69-05536

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

NUCLEAR POWER AND WATER DESALTING PLANTS FOR SOUTHWEST UNITED STATES AND NORTHWEST MEXICO.
Joint United States-Mexico International Atomic Energy Agency Study Team.

Joint US-Mex-Int At Energy Agency Rep, Sept 1968. 154 p, 69 fig, 83 tab, 5 append.

Descriptors: *Desalination, *Nuclear powerplants, *Colorado River basin, *United States, *Mexico, Pilot plants, International commissions, International Joint Commission, International waters, Water shortage, Water demand, Economics, Irrigation water, Water distribution (Applied), Arizona, California.
Identifiers: International Atomic Energy Agency.

The feasibility and economics of combined desalination and nuclear powerplants for southwest US and northwest Mexico, studied by a joint US-Mexico International Atomic Energy Agency Team are summarized. Large, dual-purpose desalting and powerplants are technically feasible and economically attractive for satisfying the long-term water and power requirements of the lower Colorado

River basin. An experimental farm is suggested as the next study project. The most promising locations for an experimental desalting and farm facility with capacities of 1 bgd and 2,000 MWE are on the border east of San Luis Rio Colorado or near El Golfo de Santa Clara. The regional water deficit is projected to increase from about 1,300 mgd in 1980 to 2,500 mgd in 1995 even if no new agriculture is developed. The cost of the first study stage, including the cost of water and power distribution system, is estimated to be from $850,000 million to about $1,000 million. Water costs would vary from about 15 1/2 to 33 cents per 1,000 gal for the least-cost location, and from 17-40 cents for the most-cost location. Electricity costs would range from 1.8 to 3.1 mills per KWH. (Knapp-USGS)
W69-05208

BASIC STUDIES OF SCALE CONTROL,
Office of Saline Water, Washington, D. C.
Chin H. Lu, B. M. Fabuss, Alex Korosi, T. R. Middleton, and J. P. DeMonico.
Monsanto Resezrch Corporation, Boston, Mass., March 15, 1969, 52 p. OSW 14-01-0001-1269.

Descriptors: *Desalination, *Scaling, *Calcium sulfate, *Scale versus process variables, *Roswell water, *Fluidized bed seeding, *Synthetic carbonate free seawater, *Natural seawater, Chemical precipitation, Solubility, Brackish water, Sea water, Dissolution rate constants, Concentration, Temperatures, Structure, Kinetic factors.
Identifiers: *Roswell water, *Fluidized bed seeding, *Synthetic carbonate free seawater.

The use of seeding techniques for scale control in saline water distillation is practiced but little is known of the fundamental aspects of the process. The objective of this work was two-fold: (1) evaluate the investigations on calcium sulfate scaling performed by contractors as requested by the Office of Saline Water; (2) conduct laboratory investigations to obtain basic information on calcium sulfate scale control. A laboratory unit was built to investigate the effects on calcium sulfate precipitation of such factors as temperature, composition, fluid dynamics, heat flux, size and weight of seeds. It was found that; (a) crystal growth was extremely slow and appeared to be the limiting process in scale formation; (b) the operating conditions were far from equilibrium; (c) the total precipitation, scale plus suspension, increased with wall temperature of the heater and the amount of seawater circulated through the heater; (d) presence of seeds in the fluidized bed heater improved the heat transfer coefficient and, hence, reduced the temperature difference between the solution and the heater wall accordingly; (e) presence of fluidized seeds did not affect the total precipitation, but did reduce the amount of scale formed. With proper size and amount of seeds, scale-free operation could be achieved; (f) dissolved organic compounds in natural sea water had no significant effect on scale formation and total precipitation. (Pruett-OSW)
W69-05334

A PILOT PLANT STUDY FOR REMOVAL OF SOLUBLE SILICA FROM ROSWELL, NEW MEXICO WATER. PHASE I. INITIAL CONSTRUCTION AND OPERATION,
Johns-Manville Products Corp., Manville, N. J.
D. W. Davis, and T. S. Brown.
Research and Engineering Center, Final Report, April 1969. 41 p, 11 fig, 6 ref. OSW 14-01-0001-1710.

Descriptors: *Silica, *Scaling, *Brackish water, *Pilot plants, Adsorption, Distillation.
Identifiers: *Activated alumina, Feedwater treatment, *Roswell plant.

Silica removal from the Roswell, New Mexico plant feedwater by adsorption on activated alumina has been demonstrated using a 7-gpm pilot plant, thus confirming laboratory work reported in OSW R and D Report 286. The pilot plant consisted of a carboxylic softener, 4 silica removal colums, each containing 550 lb. of 8-28 mesh activated alumina, and associated regeneration equipment. The silica content of the water was reduced from 10-16 mg/1 to less than 1.0 mg/1 in the two trial runs. The treated feedwater was fed to the A.T.U. pilot evaporator system for two 100-hour runs. No scaling was noted in either run at a concentration ratio of 7 and a temperature of 216F.
W69-05335

3B. Water Yield Improvement

TREATED WATERSHED YIELDS IMPROVED WATER HARVEST,
Geological Survey, Albuquerque, N. Mex.
W. C. Ballance, and J. A. Basler.
Environ Sci and Tech, Vol 3, No 2, pp 110-112, Feb 1969. 3 p, 1 fig, 2 photo.

Descriptors: *Water management (Applied), *Water yield improvement, Watersheds (Basins), Paving, Water yield, Demonstration watersheds, New Mexico, Runoff, Infiltration, Evaporation.
Identifiers: Runoff improvement, Impervious watersheds, Experimental watersheds, White Sands (N.M.).

An asphalt-coated watershed was constructed and studied in White Sands Missile Range, New Mexico, to determine the increase in surface-water runoff that may be obtained for water supply in an arid land. The 9.1 acre watershed was cleared and covered with 1/8 inch of asphalt, and a recording rain gage and V-notch weir were installed. Infiltration was measured downstream from the treated area and from a similar but untreated control area. Average rainfall is 10 inches per year. Evaporation may be as much as 100 inches per yr. The untreated watershed collected only 3% of precipitation while the treated area collected from 40% in small rainfalls to over 75% in larger events. The total cost was $4,700 or $516.40 per acre, with an estimated total 10-yr initial and operating cost of $7,774. The cost of the water recovered would be about 50.75 cents per 1,000 gal, and the average supply from the area would be 4.7 acre-ft per yr. (Knapp-USGS)
W69-05410

3C. Use of Water of Impaired Quality

ASSESSING IMPACTS OF DECLINING WATER QUALITY ON GROSS VALUE OUTPUT OF AGRICULTURE, A CASE STUDY,
Economic Research Service, Salt Lake City, Utah.
M. Glade Pincock.
Water Resources Research, Vol 5, No 1, pp 1-12, Feb 1969. 1 fig, 6 tab, 12 ref.

Descriptors: *Water quality, *Salinity, *Arizona, *Economic impact, *Crop production, Irrigation water, Salt tolerance, Damages, Withdrawal, Budgeting, Consumptive use, Water pollution, Leaching, Electrical conductance, Costs, Return (Monetary).
Identifiers: *Wellton-Mohawk Irrigation District, Arizona, Crop losses.

Continued economic development in a river basin lowers water quality in the main stream over time, since some of the water withdrawn at each diversion is consumptively used, and return flows carry pollutants to the stream. The objective of this study was to analyze impacts of irrigation water quality on projected gross value output for agriculture in the Wellton-Mohawk Irrigation District, Yuma County, Arizona. A procedure for estimating physical crop losses due to salinity was summarized from the literature. Published enterprise and farm budgets were adjusted to show damages that might be expected for a specific irrigation project. A change in water quality of the magnitude studied did not indicate an adjusted cropping pattern in response to deteriorated water quality. The method and procedures summarized here may be used in assessing the impacts of declining water quality in gross value output of agriculture for any area where sufficient basic data are available. (Affleck-Ariz)
W69-05273

QUALITY OF WATERS FROM PLAYAS ON THE SOUTHERN HIGH PLAINS,
Agricultural Research Service, Bushland, Tex.
Frederick B. Lotspeich, Victor L. Hauser, and Oliver R. Lehman.
Water Resources Research, Vol 5, No 1, pp 48-58, Feb 1969. 8 fig, 5 tab, 16 ref.

Descriptors: *Water quality, *Water chemistry, *Playas, *Surface runoff, *Texas, Runoff, Water storage, Groundwater, Aquifers, Salts, Nitrates, Hydrogen ion concentration, Electrical conductance, Watersheds (Basins), Dissolved solids, Sodium.

It is estimated that 2.5 to 3.0 million acre-feet of surface runoff accumulate annually in the thousands of playas that dot the southern High Plains. Most of this water is wasted by evaporation, but much of it could be conserved by storage in the aquifer. However, past lack of knowledge about its quality has impeded progress. A study was conducted to determine the quality of water from 13 playas in an area extending about 100 miles from northeast to southwest and covering two major soil types. The change in water quality with time was also determined. Playa water contained less salts than ground water and was of excellent quality for irrigation. Nitrate contents were less than 1.0 mg/liter in nearly all playas. Almost no nitrogen applied as fertilizer was washed into playas by runoff water. High and variable amounts of suspended solids contained in playa waters were substantially reduced by settling in deep reservoirs protected from wind and wave action. (Affleck-Ariz)
W69-05276

3D. Conservation in Domestic and Municipal Use

PROCEEDINGS-SYMPOSIUM ON BETTER WATER AND SEWER SERVICES FOR SMALL COMMUNITIES IN NORTH CAROLINA.
North Carolina Univ., Chapel Hill. Water Resources Research Inst.

North Carolina Water Resources Research Institute, Report No 15, December 1968. 113 p.

Descriptors: *Municipal water, *Municipal wastes, *Water resources planning, City planning grants.
Identifiers: Community water supply, Community sewer systems, *North Carolina.

Proceedings of a Symposium held at the Institute of Government in Chapel Hill on December 4, 1968, to examine current water and sewer problems in the context of a multitude of applicable Federal and State programs, North Carolina law and alternative governmental arrangements for the planning, financing, construction and management of water and sewer systems. Some of the principal findings were: (1) The numerous deficiencies in community water and sewer systems due to poor planning, lack of cooperation between communities and inefficient operation of systems; (2) The economic and other advantages of area wide water and sewer systems; (3) The need to attune local water development plans to regional needs and water availability; (4) The need for a sound and politically acceptable statewide program within which local government could construct and operate area wide water and sewer systems; (5) The lack of an established procedure to assure that actions taken at the local level are coordinated or that alternative arrangements for the provision of services are considered in advance; and (6) The absence of clearly established responsibility for comprehensive planning of water and sewerage services throughout the State. (Howells-N C)
W69-05312

WATER SUPPLY PROBLEMS IN DEVELOPING COUNTRIES,
International Bank for Reconstruction and Development, Washington, D. C.
Harold R. Shipman.
Jour American Water Works Association, Vol 59, No 7, pp 767-772, July 1967. 6 p, 1 ref.

Descriptors: *Water supply, *Sewerage, Urbanization, Municipal water, Loans, Feasibility studies, Management, Project planning.
Identifiers: *Unaccounted-for water, *World Bank, Local funds, Investment priorities, Technical resources.

If approximately 50 percent of the urban populations of the 86 developing countries (of the World Bank's total membership of 106) is now reasonably supplied by some sort of municipal water system, this still leaves 210 million unserved people living in urban centers. This total will probably increase to 483 million by 1980. The sewerage situation is far worse and far more costly when measured on a per capita basis. It becomes apparent that there will be need for large investment by countries to meet the needs of their people for both water and sewerage. The policy of the World Bank is that water projects for which funds will be made available should be of high priority in the country's development program, technically designed to provide maximum benefits at least cost, and capable of being supported, operated, and maintained by local personnel. The organization should have maximum opportunity to operate without undue political interference. It should be able to function as a well-run public utility, and should meet all expenses and costs out of its operating revenues. (Sokoloff-Rutgers)
W69-05513

COMPLETION OF THE FAIRFAX COUNTY WATER AUTHORITY ACQUISITION PROGRAM.
Fairfax County Water Authority, Annandale, Va.
James J. Corbalis, Jr.
Journal Am Water Wks Assn, Vol 61, No 3, pp 139-144, Mar 1969. 6 p, 2 ref, 3 tab.

Descriptors: *Virginia, *Water districts, *Legislation, *Administrative agencies, Local governments, Government finance, public utility districts, water resources development, Eminent domain, Condemnation, Gravity dams, Streams, Hydraulic structures, Pumping, Water supply, Storage tanks, Dumped storage, Judicial decisions, Legal aspects, Operation and maintenance, Equipment, Facilities, Reservoir operation, Water Yield.

The Fairfax County Water Authority was created under the Virginia Water and Sewer Authorities Act (Chapter 28, Title 15.1, Code of Virginia 1950) pursuant to a vote of the Board of County Supervisors. The creation of the authority for the purpose of acquisition, construction, operation and maintenance of an integrated county wide water system was in response to the population growth of the county and the general inadequacy of private concerns serving the area. The Authority is empowered to acquire water systems by purchase, gift, lease, or through the exercise of the power of eminent domain. In acquiring twenty systems for an aggregate expenditure of $55,700,000.00, the Authority has come to serve 43,933 customers through 438 miles of pipe delivering 46.4 mgd. The primary water source is Occoquan Creek, which has a safe yield of 65 mgd which can be increased to 75 mgd by means of reservoir level control. Financing of the Authority has been through public bond sale. The Authority acquired the largest of the incorporated water systems, the Alexandria Water Company by condemnation. The litigation condemning the water company took seven years, the company finally accepting a fair value determination of $45,231,182. This condemnation proceeding represents one of the few instances of an acquisition by condemnation of a water supply company. (Katz-Fla)
W69-05539

COHASSET WATER CO V TOWN OF COHASSET (CONVEYANCE OF WATER WORKS TO TOWN).
For primary bibliographic entry see Field 06E.
W69-05583

PEOPLE V VILLAGE OF BERKELEY (STATUTORY DUTIES UNDER WATER SUPPLY CONTRACTS).
For primary bibliographic entry see Field 06E.
W69-05584

3E. Conservation in Industry

ECONOMIC ANALYSIS OF PUBLIC WATER SUPPLY IN THE PISCATAQUA RIVER WATERSHED,
New Hampshire Univ., Durham.
Donald V. Bourcier, and Robert H. Forste.
Water Resources Research Center, Bulletin 1, March, 1967. 56 p, 25 fig, 7 photo, 7 tab, 16 ref. OWRR Project A-008-NH.

Descriptors: *Water supply, *Water utilization, *Costs, *Pricing, *Water rates, Administration, Economics, Utilities, Rivers, Watersheds (Basins), Returns to scale, Cost trends, New Hampshire, Maine.
Identifiers: *Piscataqua River, Proportionality adjustments, Plant size.

The economics of public water supply for ten firms in the Piscataqua River Watershed were analyzed in terms of the cost of production and distribution, plant size adjustments of water works systems, and variation in water use. Pricing policies were derived from analysis of the costs of production and distribution of water as reported by the water systems. Three pricing policies were presented: (1) current policy of water works systems, (2) a proposed policy of charging an average price in order to cover variable and fixed costs, (3) a proposed policy of charging an average price to cover fixed costs, variable costs and investment costs. The effects of increases in plant capacity on average costs were analyzed. A cost-trend line was calculated to provide an indication of cost economies and diseconomies. It was also shown that there were significant variations in water use in the watershed.
W69-05510

3F. Conservation in Agriculture

ECONOMICS AND FINANCING OF IRRIGATION PROJECTS,
Ministry of Irrigation and Power (India).
For primary bibliographic entry see Field 06C.
W69-05221

EFFECT OF MOISTURE REGIMES AND HARVESTS ON EFFICIENCY OF WATER USE BY TEN FORAGE CROPS,
Pennsylvania State Univ., University Park.
For primary bibliographic entry see Field 02I.
W69-05268

PESTICIDE LEVELS AND FLUCTUATION IN SOIL BACTERIA IN AN IRRIGATED FIELD AND A POND OF SOUTHWEST TEXAS,
Texas A and M Univ., College Station. Dept. of Plant Sciences.
For primary bibliographic entry see Field 05C.
W69-05272

ASSESSING IMPACTS OF DECLINING WATER QUALITY ON GROSS VALUE OUTPUT OF AGRICULTURE, A CASE STUDY,
Economic Research Service, Salt Lake City, Utah.
For primary bibliographic entry see Field 03C.
W69-05273

RUNOFF WATER-SPREADING ON LEVELED CROPLAND,
Agricultural Research Service, Akron, Colo. Central Great Plains Field Station.
For primary bibliographic entry see Field 04A.
W69-05275

VARIABLE ROW SPACING OF IRRIGATED COTTON AS A MEANS FOR REDUCING PRODUCTION COSTS AND CONSERVING WATER,
Texas Agricultural Experiment Station, El Paso.
D. E. Longenecker, E. L. Thaxton, Jr., and P. J. Lyerly.
Agron J, Vol 61, No 1, pp 101-104, Jan-Feb, 1969. 3 fig, 3 tab, 10 ref.

Descriptors: *Application methods, *Irrigation efficiency, *Cotton, *Water conservation, *Economic feasibility, Crop production, Spatial distribution, Irrigation practices, Texas, Semiarid climates, Plant populations, Evaporation, Furrows, Mature growth stage, Water distribution (Applied), Costs, Water management (Applied), Water utilization.
Identifiers: *Row spacing, Variable row spacing, Lint, Skip-row.

Studies of a new irrigated cotton row spacing pattern have been conducted at El Paso, Texas, since 1964. This new pattern, called Variable Row Spacing (V. R. S.), consisted of alternate wide (1.37m) and narrow (0.66m) rows with furrows only between the 0.66m rows. The conservation of water and reduction of production costs were the purposes of the new pattern. The V. R. S. system presented an opportunity for reducing production costs through application of less water per irrigation, reductions in evaporation, more efficient utilization of applied water, more effective weed control, and earlier maturity of the crop. A major drawback of the method has been the inability of most commercial spindle pickers to harvest the variable row spacing pattern. Adoption of this V. R. S. system would allow a greater efficiency of water use by crops in a semi-arid region where water supplies are limited and where water costs are constantly increasing. (Affleck-Ariz)
W69-05277

WATER MANAGEMENT OF FALL-PLANTED SUGAR BEETS IN SALT RIVER VALLEY OF ARIZONA,
Agriculture Research Service, Phoenix, Ariz. Water Conservation Laboratory.
L. J. Erie, and O. F. French.
Trans of the ASAE, Vol 11, No 6, pp 792-795, Nov-Dec, 1968. 7 fig, 3 tab, 4 ref.

Descriptors: *Water management (Applied), *Sugar beets, *Arizona, *Irrigation efficiency, *Autumn, Irrigation practices, Water utilization, Crop production, Moisture stress, Soil moisture, Water conservation, Soil amendments, Weight, Depth, Soil-water-plant relationships, On-site investigations.
Identifiers: *Salt River Valley, Arizona, Growing season.

There are many management opportunities for conserving water in the production of sugar beets in Arizona. Opportunities are enhanced by the long growing season which included weather extremes that directly affect water use by the plant. During 1965-66 experiments were conducted in the field to determine how much water beets used for full-season maximum production, when irrigation should be given during the growing season, and when the last irrigation should be given to make the most economical use of water. Depth from which beets utilize soil moisture was also studied. Influence of different irrigation regimes on field weights and sugar percentages was not great enough to be statistically significant. It was found that beets could extract water from a depth as great as 5 ft, but over 70 percent of use was from the top 2 ft of soil. In addition since sucrose was not

reduced by soil moisture stress, irrigation could be discontinued 3 to 4 weeks before harvest, for maximum water economy. (Affleck-Ariz)
W69-05279

EFFECT OF EARLY-SUMMER SEEDING OF WINTER WHEAT ON YIELD, SOIL MOISTURE, AND SOIL NITRATE,
Utah State Univ., Logan. Dept. of Plant Science.
W. G. Dewey, and R. F. Nielson.
Agron J. Vol 61, No 1, pp 51-55, Jan-Feb, 1969. 4 fig, 4 tab, 13 ref.

Descriptors: *Wheat, *Planting management, *Soil moisture, *Crop production, *Nitrates, Winter, Summer, Fallowing, Irrigation effects, Irrigated land, Dry farming, Utah, Nitrogen, Sampling, Moisture availability, Soil-water-plant relationships, Depth, Winterkilling.
Identifiers: *Early planting, Plots, Plant survival.

At 4 irrigated and 3 dryland sites in northern Utah winter wheat was planted at monthly intervals from June through October over a four year period. Objectives of the study were (1) to observe effects of early planting of wheat on soil moisture and nitrate reserves which are ordinarily accumulated during the fallow year, (2) to find how this premature utilization of moisture and nitrates affects the yield of wheat, and (3) to determine if the suspected deleterious effect of early planting could be offset by irrigation and addition of nitrogen fertilizer. In both dryland and irrigated trials, yields in the early-seeded plots were significantly below those of plots seeded at the later planting dates. Major factors limiting yields of early-seeded winter wheat appeared to be disease, winterkill, and possibly physiological old age. (Affleck-Ariz)
W69-05280

RELATIONSHIP OF PALMER DROUGHT VARIABLES TO YIELD OF WINTER WHEAT,
Kansas State Univ., Manhattan; Weather Bureau, Silver Spring, Md.
Merle J. Brown, and R. L. Vanderlip.
Agron J, Vol 61, No 1, pp 95-98, Jan-Feb, 1969. 2 fig, 5 tab, 9 ref.

Descriptors: *Droughts, *Wheat, *Variability, *Winter, *Crop production, Precipitation (Atmospheric), Kansas, Soil moisture, Meteorology, Meteorological data, Monthly, Moisture, Subsoil, Temperature, Weather data, Data collections, Correlation analysis, Mathematical models.
Identifiers: *Palmer Drought Index, Meteorological drought, Multiple regression.

A procedure to determine duration and intensity of meteorological drought was developed by Palmer. This study investigated the relationship of Palmer drought variables to yield of winter wheat at specific locations in western Kansas. Yield data at seven locations were correlated with monthly Palmer Drought Index and monthly moisture departure values. Monthly precipitation, monthly Palmer drought index, monthly moisture departure, and estimated monthly subsoil moisture were the variables best correlated with winter wheat yields. Using multiple regression models it was found that monthly point moisture departures accounted for more variation in point winter wheat yield than other variables. Monthly departure values apparently gave a better indication of the weather conditions during critical periods than did the Palmer Drought Index. (Affleck-Ariz)
W69-05283

EFFECT OF FATTY ALCOHOL ON CHANGE IN SOIL WATER DURING THE SUMMER FALLOW PERIOD,
Colorado State Univ., Springfield. Southeastern Colorado Branch Station.
For primary bibliographic entry see Field 02G.
W69-05284

PREDICTING FIELD DISTRIBUTIONS OF SPRINKLER SYSTEMS,
California Univ., Davis. Dept. of Water Science and Engineering.
Volker O. Branscheid, and William E. Hart.
Trans of the ASAE, Vol 11, No 6, pp 801-803, 808, Nov-Dec, 1968. 2 fig, 2 tab, 5 ref.

Descriptors: *Sprinkler irrigation, *Distribution patterns, *Forecasting, *Irrigation systems, *Water distribution (Applied), Distribution systems, Irrigation design, Irrigation efficiency, Spatial distribution, Laterals, Uniformity coefficient, Winds, Wind velocity.
Identifiers: Juxtapositioning.

Distribution of water over a field by sprinkler irrigation is an important aspect of system design and should therefore be known in advance. An approach was given for prediction of field distributions from single-sprinkler patterns. The theoretical method takes into consideration actual location of sprinklers in the field at the time of their operation. A single sprinkler and a lateral line of 13 equally spaced sprinklers were operated independently of one another at a test site. In order that their climatic conditions would be similar, both installations were run at the same time. The HSPA uniformity coefficient was used as a measure of uniformity. Lateralline sprinkler patterns, when combined, gave assumed field distribution. Single sprinkler data, when juxtaposed and overlapped, predicted field distribution as indicated by the uniformity coefficient. Results show that the juxtapositioning procedure is a valid one. (Affleck-Ariz)
W69-05285

STUDIES ON WATER USE IN PEA (PISUM SATIVUM L.),
Punjab Agricultural Univ., Hissar (India). Coll. of Agriculture.
N. K. Behl, J. S. Sawhney, and M. K. Moolani.
Indian J Agric Sci, Vol 38, No 4, pp 623-626, Feb 1968. 1 fig, 3 tab, 3 ref.

Descriptors: *Water utilization, *Water requirements, *Crop production, *Irrigation practices, *Rates of application, Irrigation effects, Flowering, Plant growth, Soil moisture, Soil-water-plant relationships, Consumptive use, Evapotranspiration.
Identifiers: *Peas, India, Grain development.

A study was conducted in Hissar, India, to determine water needs of a pea crop. Irrigation treatments consisted of no irrigation, irrigation at flowering, irrigation at grain development, and irrigation at flowering and grain development. Single irrigation either at flowering or at grain-development stage indicated an increase in yield of about 18 and 10 percent over the control. Two irrigations, one each at flowering and at grain-development stage induced an increase in yield by 27 percent over the control. The calculated rate of water use per day was low in early stages of growth and attained a peak at flowering and grain-development time. (Affleck-Ariz
W69-05287

DETERMINATION OF OPTIMUM CAPACITY OF A STORAGE RESERVOIR FOR IRRIGATION PURPOSES AS A BASIS FOR ALLOCATING COSTS IN MULTIPLE-PURPOSE PROJECTS,
Manuel E. Espinosa.
For 8 volume Proceedings see Vol 2, No 9, W69-03305. International Conference on Water for Peace, 1967, Washington: U. S. Gov't. Printing Office, Vol 8, pp 764-769, 1968. 6 p, 6 charts.

Descriptors: *Irrigation efficiency, Dams, Water demand, Water utilization, Cost allocation.
Identifiers: Rio San Juan, Puerto Rico.

Seasonal fluctuations in stream flow is lowest when irrigation needs are sometimes greatest, thus creating the necessity to create reservoirs capable of storing a large proportion of the mean annual discharge. The establishment of multi-purpose projects such as a storage reservoir creates the problem of how to allocate the costs among the various purposes involved. The object of the study is to highlight specifically the influence of storage capacity on improvements in irrigation conditions. The percentage ratio between the volume of water applied to irrigation and the theoretical volume according to the law of irrigation is called the 'annual irrigation efficiency.' Through graphical analysis of the 'annual irrigation efficiency' the order of optimum reservoir capacity required to meet the demand for water is estimated. An example showing how this method was applied in the Rio San Juan is presented. (Grossman-Rutgers).
W69-05294

PUTTING WASTE WATER TO BENEFICIAL USE - THE FLUSHING MEADOWS PROJECT,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
For primary bibliographic entry see Field 05D.
W69-05327

RETURNING WASTES TO THE LAND, A NEW ROLE FOR AGRICULTURE,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
For primary bibliographic entry see Field 05D.
W69-05328

TILLAGE METHODS TO REDUCE RUNOFF AND EROSION IN THE CORN BELT,
Agricultural Research Service, Washington, D. C.; Purdue Univ., Lafayette, Ind. Agricultural Experiment Station.
J. V. Mannering, and R. E. Burwell.
Agriculture Information Bulletin 330, pp 1-14, 1968. 14 p, 13 photo, 3 tab.

Descriptors: *Surface runoff, Water loss, Turf, *Soil erosion, Soil stabilization, *Rotations, Slopes, *Slope stabilization, Soil structure, Plant populations, Crop production, Cultivation, *Plant management, *Soil management, *Corn belt.

Recent developments in tillage methods for row crops offer effective ways to combat runoff and erosion. The development of these methods comes at an opportune time because continuous row cropping is increasing in many sections of the Corn Belt. The potential erosion hazard increases when sod-based rotations on sloping soils are replaced by continuous row crops. Sod crops protect the soil from climatic factors that cause erosion. In addition, sod crops improve soil structure for succeeding row crops. The increased use of fertilizer and higher plant populations improve crop yields and increase residue production. Thus the hazard of erosion while the land is in row crops is reduced. These practices have not, however, elimated the hazard. Other soil-conserving practices need to be considered. Investigations have shown that minimum, mulch, and ridge tillage; contour listing; and, interrow seeding reduce soil and water losses while row crops occupy the soil. Although most of these practices are more effective in reducing erosion when the row crop follows a sod crop, they are also beneficial when row crops are grown year after year.
W69-05330

SEASONAL AND DIURNAL VARIATION IN POCOSIN SHRUB MOISTURE CONTENT,
Forest Service (USDA), Asheville, N. C. Southeastern Forest Experiment Station; Forest Service (USDA), Macon, Ga. Southern Forest Fire Lab.; North Carolina Div. of Forestry.
For primary bibliographic entry see Field 02I.
W69-05331

SOIL OR FOLIAR FERTILIZATION OF WELL-DRAINED AND FLOODED SLASH PINE,
Forest Service (USDA), Olustee, Fla. Naval Stores and Timber Production Lab.
For primary bibliographic entry see Field 02G.
W69-05332

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

COMPREHENSIVE BASIN STUDY ON WHITE RIVER BASIN, ARKANSAS AND MISSOURI.
White River Basin Coordinating Committee.
For primary bibliographic entry see Field 06B.
W69-05201

FLOOD PLAIN INFORMATION, SOUTHWEST BRANCH, PRINCE GEORGES COUNTY, MARYLAND.
Corps of Engineers, Baltimore, Md.

Prepared for Maryland-Nat Capital Parks and Planning Comm. Corps Eng Flood Plain Rep, Sept 1968. 25 p, 3 fig, 8 plate, 6 tab.

Descriptors: *Floods, *Flood damage, *Flood plains, Flood control, Non-structural alternatives, Maryland, Maximum probable flood, Historic flood, Hurricanes.
Identifiers: Southwest Branch, Western Branch Patuxent River, Prince Georges County (Md), Intermediate regional flood, Standard project flood.

Flooding of the Southwest branch of the Western Branch of the Patuxent River, Prince Georges County, Maryland is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-05203

FLOOD PLAIN INFORMATION (ANACOSTIA RIVER), PRINCE GEORGES COUNTY, MARYLAND.
Corps of Engineers, Baltimore, Md.

Prepared for Maryland-Nat Capital Park and Planning Comm. Corps Eng Flood Plain Rep, June 1968. 49 p, 6 fig, 12 plate, 14 tab.

Descriptors: *Floods, *Flood damage, *Flood plains, Flood control, Non-structural alternatives, Maryland, Maximum probable flood, Historic flood, Hurricanes.
Identifiers: Prince Georges County (Md), Anacostia River, Paint Branch, Indian Creek, Sligo Creek, Standard project flood, Intermediate regional flood.

Flooding of the Northeast and Northwest branches of the Anacostia River, and Paint Branch, Indian Creek, and Sligo Creek, Prince Georges County, Maryland is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-05204

FLOOD PLAIN INFORMATION, INTRENCHMENT, SUGAR, DOOLITTLE AND DOLESS CREEKS.
Corps of Engineers, Savannah, Ga.

Prepared for DeKalb County. Corps Eng Flood Plain Rep, Apr 1968. 51 p, 24 fig, 35 plate, 18 tab.

Descriptors: *Floods, *Flood damage, Flood plains, Flood control, Non-structural alternatives, Georgia, Maximum probable flood, Historic flood.
Identifiers: Intrenchment Creek (Ga), Sugar Creek, Doless Creek, DeKalb County (Ga), Standard project flood, Intermediate regional flood.

Flooding of Intrenchment, Sugar, Doolittle, and Doless Creeks, DeKalb County, Georgia is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-05205

FLOOD PLAIN INFORMATION OF PROCTOR CREEK, METROPOLITAN ATLANTA, GEORGIA.
Corps of Engineers, Mobile, Ala.

Prepared for Atlanta Region Metropolitan Planning Comm. Corps Eng Flood Plain Rep, June 1968. 32 p, 3 fig, 11 plate, 11 tab.

Descriptors: *Floods, *Flood damage, Flood plains, Flood control, Non-structural alternatives, Georgia, Maximum probable flood, Historic flood.
Identifiers: Proctor Creek (Ga), Atlanta (Ga), Standard project flood, Intermediate regional flood.

Flooding of Proctor Creek, Atlanta, Georgia is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches.
W69-05206

FLOOD PLAIN INFORMATION ON HEADWATERS SOUTH RIVER, METROPOLITAN ATLANTA, GEORGIA.
Corps of Engineers, Savannah, Ga.

Prepared for Atlanta Region Metropolitan Planning Comm. Corps Eng Flood Plain Rep, May 1967. 19 p, 9 fig, 15 plate, 31 ref, 1 append.

Descriptors: *Floods, *Flood damage, Flood plains, Flood control, Non-structural alternatives, Georgia, Maximum probable flood.
Identifiers: South River (Ga), Atlanta (Ga), Standard project flood, Intermediate regional flood.

Flooding of the headwaters of the South River, Atlanta, Georgia is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-05207

TECHNIQUES OF WATER MANAGEMENT OF LAKE OKEECHOBEE AND THE FLORIDA EVERGLADES,
Corps of Engineers, Jacksonville, Fla. South Atlantic Div.
Clifford L. R. Walke.
Int Ass Sci Hydrol Pub No 76, Symp on Hydrol Aspects of Util of Water, Bern, Sept 25-Oct 7, 1967, pp 181-186, 1968. 6 p, 2 fig, 2 ref.

Descriptors: *Water management (Applied), *Florida, *Lakes, Lake stages, Water supply, Water control, Drainage systems, Flow control, Streamflow forecasting, Storage, Canals.
Identifiers: Lake Okeechobee, Central and Southern Florida Flood Control Project.

The initial project for Lake Okeechobee and the Everglades was intended as a means of controlling floods resulting from hurricane winds and rainfall. Now it is a part of the Central and Southern Florida Flood Control Project, which is a vast multi-purpose development providing not only flood control but also water for a variety of uses: irrigation, navigation, recreation, and preservation of the natural scenic beauty and wildlife of the Everglades. A complex system of canals, levees, ponding areas, spillways and pumping stations is required to store, retard and divert the flow from the lake and its tributaries to provide protection and assure the maximum beneficial use for each purpose. The hydrologic techniques used to determine lake and reservoir storage allocations and releases, spillway pumping station capacities, and canal discharges include almost all those encountered in applied hydrology: prediction of flood stages and flows, rainfall-runoff relations, infiltration and evaporation losses, flood routing, and salt-water intrusion. In an area less than 25 ft above mean sea level, subject to the widest variations in precipitation, and with an acute demand for water at all times, there is little margin for error in the use of these techniques. This paper describes the principal features of hydrologic analysis of the Lake Okeechobee-Everglades area. (Knapp-USGS)
W69-05223

RUNOFF WATER-SPREADING ON LEVELED CROPLAND,
Agricultural Research Service, Akron, Colo. Central Great Plains Field Station.
Rome H. Mickelson, Maurice B. Cox, and Jack Musick.
J Soil and Water Conservation, Vol 20, No 2, pp 57-60, March-April 1965. 3 fig, 2 tab, 6 ref.

Descriptors: *Runoff, *Watersheds (Basins), *Water spreading, *Water storage, *Crop production, Overland flow, Excess water (Soils), Water yield improvement, Flooding, Crop response, Consumptive use, Diversion, Colorado, Rainfall-runoff relationships, Storm runoff, Fallowing, Moisture availability.
Identifiers: *Level pans.

A system for diverting waste runoff from agricultural watersheds to level areas for spreading and storage on cropland was developed near Akron, Colorado. Objectives of the work were to evaluate the automatic water-spreading system for utilizing watershed runoff, collect information on the ratio of watershed size to leveled area and evaluate performance of different annual crops under conditions of intermittent flooding on leveled water-storage areas. The spreader system provided 4 to 7 inches of additional available water on leveled areas and this additional moisture effected substantial increases in crop yields. Owing to additional available amounts and uniform distribution of water, water use efficiencies of crops on leveled

areas were double those of crops on unleveled check strips. Runoff water-spreading on leveled cropland has a potential as a moisture conservation practice in arid climates. (Blecker-Ariz)
W69-05275

FLAT CHANNEL TERRACES,
Soil Conservation Service, McCook, Nebr.
For primary bibliographic entry see Field 02J.
W69-05282

HARBOR DEVELOPMENT PORT OF PORTLAND, MAINE.
Greater Portland Chamber of Commerce, Maine; Union Design Groups, Newport, R. I.
For primary bibliographic entry see Field 06B.
W69-05298

THE ORIGIN AND DEVELOPMENT OF THE WATERWAYS POLICY OF THE UNITED STATES,
National Waterways Conference, Inc., Washington, D. C.
William J. Hull, and Robert W. Hull.
Hull and Hull, The Origin and Development of the Waterways Policy of the United States 1967. 47 p, 159 ref.

Descriptors: *Inland waterways, *Interstate rivers, *Rivers and harbors act, *Taxation, Navigation, Legislation, Federal government, Canals, Railroads, Transportation, Natural resources, Water supply, Flood control, Conservation, Recreational facilities, Water management, Water resources development, Water resources planning act, Legal aspects.

The freedom of our nation's waterways is viewed in retrospect. The author presents an in-depth treatment of Congressional actions which have helped maintain our inland waterways as toll-free arteries of commerce. The author outlines the state of the law in the late 18th century; he then traces the evolution of statutory and case law down to the present time. The impact of the congressional crackdown on discriminatory rate policies by railroads designed to force competitive water carriers out of business is given special attention. Over the years, the policy of toll-free waterways persisted, and such policy served a variety of purposes. For example: (1) the unification of the country; (2) the furtherance of westward expansion; (3) the defeat of sectionalism; and (4) the provision of low cost transportation. The maintenance of a free waterways policy has been an essential factor in water resources development. The policy should be vigorously adhered to. (Shevin-Fla)
W69-05338

DELAWARE RIVER BASIN COMPACT.
N J Stat Ann secs 32:11D-1 to 32:11D-110 (1963); N J Stat Ann secs 32:11D-111 to 32:11D-115 (Supp 1968-69).

Descriptors: *Interstate compacts, *Water management, *River basin development, *Water allocation (Policy), Delaware River Basin Commission, Interstate rivers, Delaware River, Project planning, Navigable waters, Administration, Regulation, Water utilization, Flood plain zoning, Water resources development, Legal aspects, Standards, Coordination, Water supply, Water pollution control, Flood control, Watershed management, Hydroelectric power, Financing, State governments.
Identifiers: *Delaware River Basin Compact.

The purposes of the Delaware River Basin Compact are to promote interstate comity; to remove causes of controversy; to secure and protect present developments within the states; to encourage and provide for the planning, conservation and development of the basin's water resources; to provide for cooperation by the signatory parties; and to apply the principle of equal treatment to all water users who are similarly situated and to all users of related facilities without regard to established political boundaries. This compact has an initial duration of 100 years. A commissioner, appointed by the President of the United States and the governors of the signatory states of Delaware, New Jersey, New York and Pennsylvania make up the Delaware River Basin Commission. The general areas dealt with by the Compact are: water supply; pollution control; flood protection; watershed management; recreation; hydroelectric power; and regulation of withdrawals and diversions. (Childs-Fla)
W69-05342

DELAWARE RIVER BASIN COMPACT.

N J Stat Ann secs 32:11D-1 to 32:11D-23 (1963); N J Stat Ann secs 32:11D-111 to 32:11D-115 (Supp 1968-69).

Descriptors: *Interstate compacts, *River basin development, *Project planning, *Water management, Interstate rivers, Delaware River Basin Commission, Regulation, Coordination, Administrative agencies, Legal aspects, Conservation, Water law, Federal government, Federal-state water rights conflicts, Water resources development, Equitable apportionment, Water allocation (Policy), Diversion, Prior appropriation, Administration, Standards, Research facilities, River forecasting, Publications, Use rates, Delaware River.
Identifiers: *Delaware River Basin Compact, Comprehensive plan.

The Commission is to develop plans and projects relating to the water resources of the basin. The Commission has the power, in accordance with the doctrine of equitable apportionment, to allocate the basin's waters to and among the signatory states, and to impose conditions and release requirements related thereto. The commission is also empowered to plan, construct and operate any projects or facilities to accomplish the purposes of the compact. It may establish standards for all projects and facilities that affect the basin's water resources, including water and waste treatment plants, recreational facilities, trunk mains for water distribution, local flood protection works, small watershed management programs, and groundwater recharging operations. In addition, the commission may: conduct and sponsor research on water resources; compile and coordinate systematic stream stage and groundwater level forecasting data; conduct special groundwater investigations; prepare and publish information with respect to the water problems of the basin; and negotiate for finances. The commission may also fix or alter rates of the use of facilities which it owns or operates. (Childs-Fla)
W69-05343

DELAWARE RIVER BASIN COMPACT.

N J Stat Ann secs 32:11D-24 to 32:11D-37 (1963); N J Stat Ann secs 32:11D-111 to 32:11D-115 (Supp 1968-69).

Descriptors: *Interstate compacts, *River basin development, *Water pollution control, Flood protection, Delaware River Basin Commission, Water management, Interstate rivers, Water supply, Surface water, Groundwater, Regulation, Dams, Reservoirs, Storage, Regulated flow, Sanitary engineering, Assessments, Coordination, Treatment facilities, Classification, Warning systems, Delaware River.
Identifiers: *Delaware River Basin Compact.

The Commission is empowered to develop and implement plans and projects for the use of the basin's water for domestic, municipal, agricultural and industrial water supply. For this purpose, the Commission may construct, acquire and operate dams, reservoirs and other facilities for utilization of water resources and regulation of the use thereof. The Commission may survey and investigate, and acquire, construct, and operate projects and facilities to control potential pollution and abate existing pollution of the basin's water resources. The Commission may classify the waters of the basin and establish standards for treatment of wastes. The signatory states, in order to prevent pollution, agree to enact legislation to enable the maintenance of the basin's waters in a satisfactory condition. The Commission may also plan, construct and operate projects and facilities for flood damage reduction. The Commission is to create standards relating to the nature and extent of the uses of land in areas subject to flooding. The Commission is empowered to acquire interests in lands within the area of a flood plain for the purpose of restricting its use so as to minimize the flood hazard. (Childs-Fla)
W69-05344

DELAWARE AND RARITAN CANAL.

N J Stat Ann secs 13:13-1 to 13:13-12.12 (1968).

Descriptors: *New Jersey, *Canals, *Easements, *Water supply, Legislation, Regulation, Bridges, Flow, Maintenance, Fill, Water sources, Administrative agencies, Legal aspects, Operation and maintenance, Industrial water.
Identifiers: Delaware and Raritan Canal.

Title to the Delaware and Raritan canal, the feeder and appendages thereto, and the works and improvements erected thereon is vested in the state. Custody of the canal and feeder is vested in the Department of Conservation and Development. The canal and feeder shall continue to be a public highway. Maintenance of bridges over the canal is the responsibility of the Department of Conservation and Development. To insure continuous flow and to preserve sanitary conditions, the canal shall be kept free of weeds. Water from the canal may be sold. A tariff of tolls and lock charges is to be established for use of the canal. Easements along or across the canal may be granted, and the sale of lands not needed is premitted. The canal is to be used as a source of industrial water supply and for recreational purposes. (Childs-Fla)
W69-05361

DRAINAGE AND FLOWAGE OF LANDS.

N J Stat Ann secs 15:5-1 to 15:5-4, 15:5-9, 15:5-11 (1939). N J Stat Ann sec 15:5-6 (Supp 1968).

Descriptors: *New Jersey, *Drainage, Legislation, Administration, Tides, Grasslands, Marshes, Coastal marshes, Marsh management, Drainage effects, Flooding, Legal aspects, Financing, Overflow, Banks, Bank protection, Planning, Operation and maintenance.

Section 15:5-1 provides for the election of commissioners by the owners of meadow and marsh lands and for the measuring and assessing of these lands for drainage by the elected commissioners. Section 15:5-2 limits the assessments for drainage to those made with reference to the benefits resulting from such drainage. Section 15:5-3 allows land contained within the boundaries of a meadow company to be flooded and for control of the overflow as may be agreed upon in sections 15:5-4 and 15:5-7 of this title. Section 15:5-4 provides that the proposition to have meadow land subject to overflow may be submitted to the owners of these lands, however, notice must be given in writing, published and posted. Section 15:5-6 provides that if two meadow companies abut each other, it may necessitate the erection of a cross bank to protect one from the overflow or fire of the others, in which case three commissioners shall be appointed by the county court to lay out the correct bank. Section 15:5-9 provides for and regulates the operation and financing of various projects and undertakings of such companies. Finally, section 15:5-11 deals with the improvement and protection of islands against tides by owners. (Heckerling-Fla)
W69-05362

BEACH FRONTS AND WATERWAYS.
N J Stat Ann secs 40:29-1 to 40:29-11 (1967).

Descriptors: *Coastal engineering, *Erosion, *Encroachment, *Shore protection, New Jersey, Legislation, Beaches, Waterways, Local governments, United States, Sea walls, Bulkheads, Jetties, Beach erosion, Inland waterways, Financing, Dams, Condemnation, Legal aspects.

Counties bordering the Atlantic Ocean are permitted to pay funds into the United States Treasury to be expended by the Federal Government for the erection of any works necessary to preserve the coast of any municipality in the county against encroachments and to protect the inland waterways, navigable rivers, public roads, and public property. The municipality to be protected must make equal payment. Counties may also appropriate funds for the purpose of constructing any waterway connecting as a cutoff with any river or for the purpose of deepening, widening, and straightening any such waterway. A county may also pay funds to a municipality to be used for the improvement of a brook or watercourse. The municipality's plans for a drainage system must first be approved by the county. Work on the proposed improvement shall be done by the municipality. Bonds may be issued to finance the improvements. Certain counties may expend funds to control the flow of water in brooks and streams in the county. Flumes, dams, and other structures may be erected for this purpose. The county may also expend funds for municipal beach protection. (Childs-Fla)
W69-05363

WATERWAYS AND WATER FRONTS.
N J Stat Ann sec 40:14-1 to 40:14-15 (1967).

Descriptors: *New Jersey, *Inlets, *Channel improvement, *Erosion control, Legislation, Legal aspects, Local governments, Waterways, Streams, Canals, Inland waterways, Navigable waters, Channels, Bulkheads, Jetties, Financing, Cities.

Counties and municipalities may open or keep open any inlet, stream, canal, basin or other public waterway which is either within or forms the boundary of such county or municipality. Counties and municipalities may appropriate money for port or harbor commissions. Inland waterways or navigable streams may be improved by counties or municipalities through joint action. Counties may appropriate up to seventy-five hundred dollars in any one year for the purpose of constructing a permanent inlet through which any river or creek running in such county may be connected with the ocean. The appropriations may also be used in making permanent improvements on such inlet. At their own expense, counties and municipalities bordering the Delaware River may construct bulkheads and other structures to prevent erosion by said river. (Childs-Fla)
W69-05364

REMOVAL OF BUSHES, TREES, AND STUMPS FROM FLOWED AREA.
Me Rev Stat Ann tit 17, sec 2800 (1965).

Descriptors: *Maine, *Dams, *Beds under water, *Navigation, Legislation, Lumbering, Low water mark, Water levels, Water flow, Trees, Shrubs, Channeling.
Identifiers: Stumps.

Whoever erects a dam on any public waters shall, within 3 years after a head of water is held and flowage is created, remove from the flowed area all trees, bushes, and stumps to the extent that their tops shall be at least 5 feet below the surface of the mean low-water level maintained during the period of June 1st to December 1st. Also, he must remove such growth as he can legally remove from the edge of the flowed area so that no dry-ki and debris form to be carried away by the water. This statute does not apply to dams created solely for logging purposes where the water is stored for less than 3 months, nor does the statute require the removal of stumps below the swell of the roots. Any dam maintained in violation of this section shall constitute a public nuisance, and be subject to Maine Rev Stat Ann tit 17, sec 2706 (1965). (Logan-Fla)
W69-05368

NUISANCES-MILLS AND DAMS; FENCES AND BUILDINGS ON PUBLIC WAYS.

Me Rev Stat Ann tit 17, sec 2797 (1965).

Descriptors: *Maine, *Non-navigable waters, *Streams, *Mill dams, Legislation, State governments, Legal aspects, Dams, Public health.
Identifiers: Nuisance (Non-water polluting).

The erection and maintenance of watermills and dams upon or across non-navigable streams shall not be deemed a nuisance unless they become offensive to the neighborhood, injurious to the public health, or occasion injuries or annoyances of a kind not authorized by Maine Rev Stat Ann chapter 91. (Logan-Fla)
W69-05369

DAMAGE TO ICE.
For primary bibliographic entry see Field 06E.
W69-05371

MOORING WATERCRAFT TO BUOYS OR BEACONS.
For primary bibliographic entry see Field 06E.
W69-05373

HARBORS, WHARVES, AND HARBOR MASTERS.

Mich Comp Laws Ann secs 67.35-67.39 (1967).

Descriptors: *Michigan, *Legislation, *Harbors, *Taxes, Sewage treatment, Docks, Cities, Legal aspects, Local governments, Boating regulations, Water quality, Navigable waters, Construction costs, Ditches, Drains, Rates, Rivers, Water purification.
Identifiers: *Harbor masters.

Village councils may levy a general tax to defray the expenses of repairing public sewers, ditches and watercourses, and it may enact ordinances necessary for the protection and control of public drains and sewers. The council may construct and maintain public wharves, docks and other appertenances on navigable waters of the state which are adjacent to the village and it may lease wharfing and landing privileges upon such but not for a period of more than 10 years. The council can require all wharves, docks and landing places, whether public or private, to be constructed and maintained in conformity with such grade as it establishes. The council may prohibit the encumbering of these public facilities and may proscribe rates and charges for their use. The council may provide ordinances for the preservation of the purity of the waters of any harbor, river, or other waters within the village and to regulate the use of the navigable waters to promote the safety and convenience of water craft operating therein. A harbor master may be appointed to enforce such regulations. (F. Molica-Fla)
W69-05377

POIRE V SERRA (PROPRIETY OF LAND FILL BY RIPARIAN OWNER).

106 A 2d 391-393 (N H 1954).

Descriptors: *Landfills, *Sedimentation, *Diversion, *New Hampshire, Judicial decisions, Alteration of flow, Reasonable use, Riparian land, Riparian waters, Deposition (Sediments), Sediment transport, Running waters, Obstruction to flow, Riparian rights, Legal aspects.
Identifiers: Injunctions (Mandatory).

Plaintiffs brought suit to enjoin filling operations in a river adjacent to their property and to obtain removal of the portion of the wall and fill already in place. Plaintiffs contended that the fill was causing an undue amount of sedimentation buildup at their boat dock and constituted an obstruction. Plaintiffs objected to a finding that the present fill was not an obstruction; this court affirmed the holding below. A riparian owner is entitled to beneficial use of water passing through or adjacent to his land without responsibility for the consequences of such use on others; such use, however, must be reasonable. What constitutes a reasonable use depends upon a variety of conditions--the size and character of the stream and the uses to which the water can or is being applied. Whether a diversion of or interference with a stream is rightful must depend upon whether, under all the circumstances such diversion or interference is reasonable. The extent of benefit to one party and inconvenience or injury to the other are factors to be considered in making this determination. The evidence did not show a material change in the river flow, any appreciable sedimentation on the plaintiffs' land, or any substantial damage. (Blunt-Fla)
W69-05381

JOHNSON V RAY (RIGHT TO CONSTRUCT RETAINING WALL)

265 SW 2d 782-784 (Ky 1954).

Descriptors: *Kentucky, *Retaining walls, *Riparian rights, *Streamflow, Judicial decisions, Land tenure, Stream improvement, Legal aspects, Damages, Remedies, Relative rights, Streams, Obstruction to flow, Precipitation excess.
Identifiers: Injunctions (Mandatory), Irreparable damages.

Plaintiff sought and obtained a temporary injunction restraining defendant from building a retaining wall on his side of a creek separating their adjoining tracts of land. Plaintiff alleged that the wall footing was in the creek bed and, as so situated, would cause overflow onto her property. However, plaintiff was unable to prove irreparable damage, and the injunction was dissolved. The defendant subsequently completed the wall. The circuit court then entered a judgment ordering removal of the wall. Defendant appealed. The Court of Appeals held that the evidence tended to prove that the wall constituted a benefit to plaintiff's land rather than a detriment. The wall lessened the chance of overflow, which occasionally occurred during heavy rains. A mandatory injunction is of such serious nature that proof of irreparable injury must be shown before it will issue. The casting of a few rocks on plaintiff's shore was not sufficient injury to warrant an injunction. (Harris-Fla)
W69-05382

CITY OF HARDIN V NORBORNE LAND DRAINAGE DISTRICT (STATUTORY RIGHTS TO MAINTAIN EXISTING LEVEES).

232 SW 2d 921-926 (Mo 1950).

Descriptors: *Missouri, *Levees, *Repulsion (Legal aspects), *Surface runoff, Overflow, Surplus water, Judicial decisions, State governments, Water law, Drainage districts, Construction, Maintenance, reclamation, Remedies, Legislation, Damages, Legal aspects.
Identifiers: Injunction (Prohibitory).

Appellants sought to enjoin respondent drainage district from constructing a new levee. Appellants owned property outside the district, and they alleged that the levee would prevent the natural drainage of overflow water and cause inundation of their property. In 1924, respondents obtained a plan for reclamation, as required by statute, and constructed the present levee. The above mentioned statute also provided powers to maintain and protect the drainage district by strengthening, repairing, and maintaining existing levees. Appellants contended that respondent was seeking to

construct a new levee rather than maintain a pre-existing one. The court held that respondent was acting under statutory power when proposing to raise the height of the existing levee and that, since a new levee was not actually going to be built, a new plan for reclamation was unnecessary. The court further stated that the district was entitled to fend off overflow water under the common enemy doctrine. The overflow water was to be considered surface water and could be dealt with as such under the above mentioned doctrine. (Holt-Fla)
W69-05384

ENDERSON V KELEHAN (UPLAND DRAINAGE OF SURFACE WATERS).

32 NW 2d 286-290 (Minn 1948).

Descriptors: *Minnesota, *Diversion structures, *Overland flow, *Surface runoff, Subsurface runoff, Surface waters, Storm runoff, Precipitation (Atmospheric), Reasonable use, Drainage effects, Drainage engineering, Controlled drainage, Surface drainage, Drainage systems, Natural flow, Legal aspects, Judicial decisions, Ditches, Hydraulic structures.
Identifiers: Easements, Servitudes.

Plaintiff sought to enjoin defendant from diverting certain surface waters onto the land of the plaintiff located below that of the defendant. The court held that a landowner, in effecting a reasonable use of his property for a legitimate purpose and acting in good faith, may drain his land of surface waters and cast them upon the land of another. This is so even if such drainage carries with it some waters which would otherwise have remained on the land until evaporated or absorbed. The abovementioned right is qualified in that a reasonable necessity must exist for such drainage and reasonable care must be taken to avoid unnecessary injury to the servient estate. The benefit accruing to the land to be drained must reasonably outweight the gravity of the harm resulting to the land burdened by the servitude, and, wherever practicable, the natural drainage system should be utilized. The court found that the defendant had complied with the above principles and qualifications and dismissed the complaint. (Katz-Fla)
W69-05390

BURT V MUNGER (EROSION CONTROL AND LANDFILL BY RIPARIAN OWNER).

314 Mich 659, 23 NW 2d 117-120 (1946).

Descriptors: *Retaining walls, *Ownership of beds, *Michigan, *Riparian rights, Check structures, Riparian lands, Hydraulic structures, Lakes, Bank protection, Bank stability, Erosion control, Flood control, Landfills, Judicial decisions, Legal aspects, Reasonable use, Real property, Relative rights.

Plaintiff, owner of a parcel of land abutting an inland lake, sought a declaratory judgment concerning his right to appropriate a portion of the lake bed. Periodic changes in the level of the lake had resulted in erosion of plaintiff's beach head and, to counteract this erosive effect, plaintiff desired to construct a retaining wall extending several feet out on the lake bed. Plaintiff proposed to fill the area between the retaining wall and the shoreline by dredging fill from the lake bottom. Defendant successfully objected to the plaintiff's proposal, contending that a riparian owner may not interfere with the reasonable use of the lake by other riparian owners and that the proposed alterations would effectively and materially curtail the use of the lake by such riparian owners. The court refused to allow construction of the retaining wall in the manner proposed by the plaintiff, recognizing that such construction would increase the extent of the plaintiff's land, thereby reducing the surface area of the lake to the detriment of the other riparian owners. (Katz-Fla)
W69-05391

TURNER V SMITH (RESERVOIR OBSTRUCTING LAND DRAINAGE).
231 SW 2d 110-113 (Ark 1950).

Descriptors: *Natural streams, *Surface waters, *Obstruction to flow, *Arkansas, Judicial decisions, Legal aspects, Watercourses (Legal), Riparian rights, Natural flow doctrine, Surface drainage, Channels, Ditches, Surface runoff, Swamps, Land reclamation, Reservoirs, Damages, Cotton, Crops, Bayous, Levees, Relative rights, Remedies, Riddance (Legal aspects), Repulsion (Legal aspects).
Identifiers: Dominant estate, Servient estate.

Plaintiff sought to enjoin maintenance of a reservoir which was allegedly obstructing the natural drainage of plaintiffs' land. Plaintiffs were upper land holders whose land was flooded and whose crops were damaged following construction of defendant's reservoir. The issue to be decided was whether waters coming upon defendant's property were in natural watercourses or were merely surface waters; if the former, then defendant had no right to impede the flow. In finding for the plaintiff, the court noted that defendant was obstructing the flow of at least two natural watercourses which, even though they temporarily flowed without well-defined banks, never became surface water. The court carefully added that defendant could reclaim his land by confining these streams passing over his land to ditches and channels which would clear his land of water and yet not impede the flow from other property. (Logan-Fla)
W69-05392

DODD V BLEZEK (DETERMINATION OF DOMINANT ESTATE AND DRAINAGE RIGHTS IN NATURAL STREAM).

66 NW 2d 104-109 (Iowa 1954).

DESCRIPTORS: *Surface drainage, *Natural streams, *Obstruction to flow, *Iowa, Natural flow doctrine, Alteration of flow, Flow, Drainage, Elevation, Floods, Backwater, Remedies, Legal aspects, Judicial decisions, Dikes.
Identifiers: *Swales.

Plaintiff sought to enjoin the obstruction of the natural flow of water from the plaintiff's land. The obstruction was caused by defendant's dike. The trial judge held that defendant's land was servient to that of plaintiff's for drainage purposes through three natural swales and an injunction should be issued. The defendant appealed. The court held the trial judge was correct in using the course of flood waters as a consideration in determining the general elevations of land as effects drainage. The court also ruled that a swale was a natural watercourse and that the owner of a dominant estate had the right to drain his estate into a natural watercourse unless there is an increase in water which materially results in damages to the lower estate. (Gabrielson-Fla)
W69-05393

JOHNSON V CITY OF WINSTON-SALEM (ACTION FOR DAMAGES CAUSED BY AN OBSTRUCTED DRAIN PIPE).

81 SE 2d 153-161 (N C 1954).

Descriptors: *North Carolina, *Flood damage, *Subsurface drainage, *Obstruction to flow, Judicial decisions, Drains, Pipes, Drainage, Surface water, Natural flow, Legal aspects, Channel flow, Operation + maintenance, Drainage systems, Culverts.
Identifiers: Natural drainage, Equitable servitudes.

Lower proprietors brought suit to recover from an upper proprietor for flood damage caused when a large subsurface drain pipe running under the upper proprietor's property became obstructed and overflowed. The court stated that the upper property owner had the burden of exercising ordinary care to maintain the artificial drain so as to accommodate the natural flow of surface waters. Where the purchaser of land had notice of the artificial underground drainage system created by the vendor in lieu of a natural channel of open drainage, the property passed to the purchaser subject to all existing servitudes with respect to maintenance of the underground drainage system. When a private line of drainage is connected with a municipal culvert without dedication by the private owner or control by the municipality, the municipality is ordinarily not liable for damages caused by a break in the private line. It was held to be a jury question as to whether the upper proprietor had been negligent in failing to keep the drain pipe in proper condition. (Childs-Fla)
W69-05394

BOAT V VAN VEEN (INTERFERENCE WITH WATER FLOW).

44 NW 2d 671-676 (Iowa 1950).

Descriptors: *Levees, *Iowa, *Alteration of flow, *Natural flow doctrine, Drainage, Ditches, Dams, Legal aspects, Judicial decisions, Relative rights, Obstruction to flow, Local governments, Floods, Flood water, Flood routing.
Identifiers: Injunctions (Mandatory).

Plaintiffs brought action to enjoin maintenance of a levee and wing dam on defendants' property which allegedly caused flooding of plaintiffs' land. The levee had been constructed from excavated dirt from a drainage canal created in 1915 by the county. The wing dam was erected by defendants in 1945. The Supreme Court held that the natural flow of water cannot be arrested or interfered with by one landowner (whether servient or dominant) to the injury of another. The court found that the levee was created by the county for drainage improvement and had not been interfered with by defendants. Injunctive relief as to the levee was denied. The wing dam, however, substantially increased the flow by narrowing the course for flood water; the court ordered its removal. (Kahle-Fla)
W69-05395

CICONTE V SHOCKLEY (RUNOFF NUISANCE).

75 A 2d 242-244 (Del Ch 1950).

Descriptors: *Delaware, *Precipitation excess, *Repulsion (Legal aspects), *Riddance (Legal aspects), Drainage waters, Runoff, Surface runoff, Surface waters, Roofs, Flooding, Judicial decisions, Legal aspects, Drains, Relative rights, Discharge (Water), Remedies.
Identifiers: Injunctions (Mandatory), Injunctions (Prohibitory).

Plaintiff sought to enjoin continuance of an alleged nuisance resulting from defendant's construction of the roof of a house sloping toward plaintiff's adjoining lot without gutters and downspouts to carry off water. The maintenance of the above mentioned condition caused flooding of the plaintiff's premises. The court recognized that an upper proprietor is not required to take any steps to prevent the flow of surface water from his premises onto the adjoining land so long as such flow results from maintenance of the land in its natural state. An upper proprietor may not, by artificial means, collect and discharge surface water in increased and unnatural quantities upon the land of his neighbor so as to cause substantial injury or damages. The injunction was granted. (Katz-Fla)
W69-05396

LUCAS V FORD (EASEMENT - SURFACE WATER DRAINAGE).

363 Pa 153, 69 A 2d 114-116 (1949).

Descriptors: *Pennsylvania, *Repulsion (Legal aspects), *Riddance (Legal aspects), Drainage

water, Drainage systems, Pipes, Hydraulic structures, Coal mines, Easements, Surface water, Precipitation excess, Drainage waters, Runoff, Highways, Judicial decisions, Legal aspects, Water pollution, Relative rights.
Identifiers: Injunctions (Prohibitory).

Plaintiff sought to enjoin defendants from allowing dirt and foreign substances to be washed upon plaintiff's property. Defendants operated and maintained a coal tipple which abutted plaintiff's property. Subsequent to construction of a roadway from an adjacent state highway to the coal tipple, the defendants installed two drainage pipes to prevent erosion of their property by surface waters running off the state highway. These pipes deposit the matter in question upon the plaintiff's property. The court held that an upper proprietor may discharge surface water flowing over his land onto the adjoining lower land by use of natural watercourses. Plaintiff's allegations concerning the change in quality of the water were insufficient as the evidence showed that the foreign substances and dirt complained of originated from the state highway runoff. (Katz-Fla)
W69-05397

COUNTY COMMISSIONERS OF BALTIMORE COUNTY V HUNTER (DRAINAGE EASEMENT NUISANCE).

113 A 2d 910-915 (Md Ct App 1955).

Descriptors: *Maryland, *Right of way, *Ditches, *Repulsion (Legal aspects), Water conveyance, Drains, Drainage systems, Pipes, Precipitation excess, Runoff, Surface waters, Drainage water, Sewers, Cities, Local governments, Operation + maintenance, Judicial decisions, Legal aspects, Relative rights, Remedies.
Identifiers: Injunctions (Prohibitory).

Plaintiff upper landowners sought to enjoin defendants from obstructing an open drainage ditch. Defendants filed an equitable counterclaim seeking to enjoin plaintiffs from excessive discharge and discharge of water and other debris upon the lower property. The court recognized that the law of Maryland concerning drainage easements entitled owners of upper land to have surface water flow naturally over the land of lower proprietors. The court held that plaintiffs' use of the ditch in question was reasonable. However, the court directed plaintiffs to prevent debris from flowing with the water across the defendants' property. (Katz-Fla)
W69-05400

FLOOD PLAIN INFORMATION OF ELLICOTT CREEK IN CITY OF TONAWANDA AND VICINITY, ERIE COUNTY, NEW YORK.
Corps of Engineers, Buffalo, N. Y.
For primary bibliographic entry see Field 02E.
W69-05458

FLOOD PLAIN INFORMATION OF DUCK CREEK, GARLAND, TEXAS.
Corps of Engineers, Fort Worth, Tex.
For primary bibliographic entry see Field 02E.
W69-05459

FLOOD PLAIN INFORMATION, SOUTH MESQUITE CREEK, MESQUITE, TEXAS.
Corps of Engineers, Fort Worth, Tex.
For primary bibliographic entry see Field 02E.
W69-05460

FLOOD PLAIN INFORMATION, TENMILE CREEK, DALLAS COUNTY, TEXAS.
Corps of Engineers, Fort Worth, Tex.
For primary bibliographic entry see Field 02E.
W69-05461

FLOOD PLAIN INFORMATION OF CATTARAUGUS CREEK, ARCADE, WYOMING COUNTY, NEW YORK.
Corps of Engineers, Buffalo, N. Y.
For primary bibliographic entry see Field 02E.
W69-05462

WATER RESOURCES LAWS IN VIRGINIA (NATURAL SURFACE WATERCOURSES).
For primary bibliographic entry see Field 06E.
W69-05534

RAU V WILDEN ACRES, INC (ACCUMULATION-RIDDANCE).

68 York Legal Record 157-162 (C P Pa 1955).

Descriptors: *Pennsylvania, *Repulsion (Legal aspects), *Riddance (Legal aspects), Overlying proprietor, Reasonable use, Contours, Flow control, Runoff, Drainage water, Surface waters, Precipitation excess, Rain water, Ditches, Natural flow doctrine, Alteration of flow, Obstruction to flow, Real property, Flooding, Judicial decisions, Legal aspects, Remedies.

The plaintiff brought this action to enjoin the owner of a higher, neighboring land from artifically draining surface water from his property onto that of the plaintiff. The defendant contends that the plaintiff's land is servient to an easement of the upper land for drainage purposes and that defendant has acted without negligence and, therefore, any unavoidable loss sustained by the plaintiff is damnum absque injuria (harm without injury). Specifically, the plaintiff alleges that defendant changed the contour of his land in such a manner as to concentrate the waters draining therefrom and to insure that these concentrated waters were quickly removed from defendant's property, the defendant constructed a nine foot deep ditch with raised sides which emptied with considerable force onto the plaintiff's property. The court determined that the use of defandant's land for the purpose of a sub-division was reasonable but that the diversion of surface water from its natural flow by construction of the ditch with the resultant inundation of plaintiff's land was unreasonable. (Katz-Fla)
W69-05544

LAWRENCE V EASTERN AIRLINES (DIVERSION OF NATURAL FLOW).
81 So 2d 632-634 (Fla 1955).

Descriptors: *Florida, *Diversion, *Natural flow, Surface runoff, Rainfall disposition, Surface waters, Legal aspects, Cities, Natural flow doctrine, Remedies, Judicial decisions, Damages, Ditches, Drainage, Dams, Alteration of flow, Riparian rights, Relative rights, Running waters.
Identifiers: *Nuisance.

Plaintiff brought this action for damages against defendant airline and town for private nuisance caused by the diversion of the natural flow of water onto plaintiff's land. The court held that no person has the right to gather surface waters naturally flowing in one direction by drainage, ditches, dams, or otherwise, and divert them onto the lands of the lower owner so as to cause injury. Furthermore, plaintiff could recover damages for such diversion even though some of the alleged acts of defendants had antedated the plaintiff's acquisition of his property. The court found plaintiff's complaint sufficient under the liberal system of pleading to withstand a motion to dismiss. (Reed-Fla)
W69-05546

DROGMILLER V OLSON (OBSTRUCTION TO NATURAL COURSE OF DRAINAGE).

40 NW 2d 292-303 (Iowa 1949).

Descriptors: *Iowa, *Ditches, *Dikes, *Check structures, Hydraulic structures, Flood control, Flood protection, Drainage water, Drainage systems, Highways, Roadbanks, Repulsion (Legal aspects), Riddance (Legal aspects), Natural flow, Legal aspects, Judicial decisions, Prescriptive rights, Artificial watercourses.

Plaintiff sought to compel removal of claimed obstructions placed along a public highway by the defendant Board of Supervisors. Such obstruction allegedly interfered with the natural flow of surface waters from the plaintiff's land. The defendant asked that the plaintiff be enjoined from diverting water onto a public highway. The plaintiff had constructed an artificial watercourse diverting water by means of a ditch to a channel running beneath the defendant's bridge span. In response to requests of landowners downstream from the channel the defendant constructed a wing dike to repel the waters being so diverted by the plaintiff. The court refused to sustain the plaintiff's contention that the artificial watercourse had become a natural watercourse, which may occur as between private individuals, since prescriptive rights cannot be acquired against the public. The plaintiff was ordered to remove his dike. To insure against flood damage to all parties concerned, the Board was ordered to remove its dike within thirty days after plaintiff removed his and was further ordered to remove such accumulated silt from beneath its bridge span as was necessary to facilitate drainage of the waters naturally flowing there. (Katz-Fla)
W69-05547

TOWN OF VIENNA V STATE (PRESCRIPTIVE RIGHTS DOCTRINE AS APPLIED TO PUBLIC PROPERTY).
119 N Y S 2d 545-552 (Ct Cl 1953).

Descriptors: *Prescriptive rights, *Flood damage, *Dams, *New York, Judicial decisions, State governments, Cities, Land use, Navigation, Canals, Watercourses, Easements, Lakes, Dam construction, Diversion, Flood waters, Rivers, Water level fluctuations, Water law.
Identifiers: *Public purposes.

Plaintiff, a municipality, brought suit against the State of New York to recover for flood damage to a highway caused by the state's dam. The highway, which was dedicated to the public use was used continuously except for the annual springtime flooding. Flooding was caused by the maintenance of the water level behind the dam at an unchanged level for purposes of navigation. The defendant contended that the state had acquired a prescriptive right to continue to maintain the water level at that height and to divert the resulting flood waters on to neighboring lands. Defendant based this contention on the fact that the annual flooding had occurred for the last fifteen years without interruption or complaint. The court held for the plaintiff, ruling that the doctrine of prescription was not available to the defendant. It is settled law that there can be no prescriptive right against property dedicated to a public use. As a consequence, the defendant did not have an easement to annually flood the public highway. (Stewart-Fla)
W69-05549

BUDA V STATE (ARTIFICIAL CONTROL OF SURFACE WATERS).

97 NYS 2d 37-54 (Ct Cl 1950).

Descriptors: *Aqueducts, *Flood waters, *Engineering, *Structures, Judicial decisions, Streamflow, New York, State governments, Precipitation excess, Surface waters, Surface runoff, Creeks, Ditches, Canals, Flood damage, Muck soils, Soil porosity, Culverts, Erie Canal, New York State Barge Canal, Legal aspects.
Identifiers: Proximate causation.

Plaintiff brought suit to recover for damage to land cause by overflow of a creek. Plaintiff alleged that the overflow was caused by the negligent reconstruction of the defendant's aqueduct which car-

ried waters of the Erie Canal above the creek. In addition, the plaintiff alleged that, had the aqueduct been in tact on the dates of the flooding, such flooding would not have occurred. On the basis of expert testimony, the court found that the defendant was not negligent and entered judgement accordingly. The proximate cause of the flood was excess precipitation. There was nothing improper about the reconstruction method. Ordinarily, in the obstruction of streams or construction of dams, there is a good chance that accumulating waters will overflow onto neighboring lands. In such case, the party constructing the dam may be liable for damages. In this case, the structure was placed above the stream. There was no structure erected in the stream which would cause flooding. As a result, there is no liability imposed on the defendant. (Stewart-Fla)
W69-05550

BOBO V YOUNG (ARTIFICIAL DRAINAGE OF SURFACE WATERS AND NATURAL FLOW).

61 So 2d 814-816 (Ala 1952).

Descriptors: *Alabama, *Dams, *Natural flow, *Surface waters, Judicial decisions, Surface drainage, Runoff, Streamflow, Ditches, Drainage waters, Slopes, Running waters, Abatement, Flood control, Watercourses, Natural streams, Obstruction to flow, Legal aspects, Backwater, Relative rights.
Identifiers: *Estoppel, Trespass, Nuisance, Consent, Affirmative defenses.

Plaintiff, an upper riparian landowner, brought suit to compel removal of a dam which defendant had built. It was alleged that the dam caused water to back up onto plaintiff's property. Ordinarily, the casting of water upon the land of an upper proprietor is a trespass for which the tortfeasor must pay damages. However, the defendant alleged and proved that he had obtained plaintiff's consent to the construction of the dam. Consent is a good defense to an action for trespass. The defendant acted in reliance on plaintiff's manifestations of assent. Plaintiff is now estopped to claim trespass and to recover for resulting damages. (Stewart-Fla)
W69-05551

PETERSON V WISCONSIN RIVER POWER CO (PROPERTY ENCROACHMENT BY IMPOUNDED WATERS).

264 Wis 84, 58 NW 2d 287-289 (1953).

Descriptors: *Wisconsin, *Dams, *Damages, *Seepage, Reservoirs, Condemnation, Eminent domain, Flooding, Flood damage, Water level fluctuations, Impounded waters, Operation and maintenance, Real property, Surface drainage, Natural flow doctrine, Judicial decisions, Legal aspects, Hydraulic structures, Hydroelectric plants, Levees.

Plaintiffs brought action against defendant power company for damages to their land caused by seepage of water from the defendant's Wisconsin River dam. The plaintiffs specifically alleged that the dam created a large body of water behind the dam and that the raised water level of that lake had encroached upon plaintiffs' lands and destroyed the drainage on these lands. The defendants denied any encroachment upon plaintiffs' property and, by way of a counterclaim, sought to have any damages declared by the court to have been incurred by the plaintiffs termed permanent and to have damages awarded in conformity therewith. The court held that if the damages alleged are proved to be temporary, then the plaintiffs are entitled to money damages. If the damages proved are of a permanent nature, then the plaintiffs cannot seek recompense for such damages in tort, but must commence condemnation proceedings in county court. The cause was remanded to determine the nature of the injury. (Katz-Fla)
W69-05552

COATES V UNITED STATES (TAKING OF PROPERTY FOR PUBLIC PURPOSE WITHOUT JUST COMPENSATION).
93 F Supp 637-640 (Ct Cl 1950).

Descriptors: *Eminent domain, *Surface water, *Soil erosion, *Deposition (Sediments), Missouri River, Engineering structures, Navigable rivers, Floods, Riparian owners, Land use, Crop production, River flow, River beds, Soil invasion, Judicial decisions, Damages, Alteration of flow, Compensation.
Identifiers: *Negligence.

Plaintiffs brought suit to recover for damage to their farm land. To improve the navigability of the Missouri River, the defendant erected certain structures which changed the character, course, and flow of the river. These changes caused flooding and erosion of the plaintiffs' property, followed by the deposition of several feet of sand onto the land; this destroyed its productivity. The defendant contended that it is not liable, where there is no direct invasion, for damages caused by a change in the character and course of the waters resulting from the lawful and non-negligent erection of structures. The plaintiffs contended that the construction by defendant raised the water level above its safety mark and directly caused the damage. Such action constituted a taking of private property for public purpose without just compensation. The court found for the plaintiff. It held that the defendant's acts were not to maintain the status quo of the river but to alter natural conditions. If these acts directly and necessarily caused the damage, the plaintiffs are entitled to recover for invasion and a taking of private property without just compensation. (Stewart-Fla)
W69-05554

GWINN V MYERS (SUIT TO REMOVE OBSTRUCTION TO NATURAL WATERCOURSE).

129 NE 2d 225-229 (Ind 1955).

Descriptors: *Indiana, *Watercourses (Legal), *Natural streams, *Surface runoff, Judicial decisions, Riparian rights, Obstruction to flow, Ditches, Channels, Drainage, Tile drains, Subsurface drains, Banks, Surface drainage, Surface waters, Legal aspects.

Suit was brought to compel removal of a dam constructed by defendant upon his land at its boundary with land of plaintiff. In affirming the lower court decision for plaintiff the court took notice that a lower riparian owner (defendant herein) may protect himself against surface water of the upper riparian owner. But once this surface water reaches or becomes a natural watercourse, one which flows in a definite direction within banks and forms a channel that is permanent for all practical purposes, it takes on other legal characteristics. Among these is that a natural watercourse may not be obstructed by a lower landowner. The factual issue involved was whether the water flowing in a surface channel, which was above a tiled drainage ditch that had been covered, was a natural watercourse. The court held that it was. (Logan-Fla)
W69-05557

REESE V STATE (DAMAGE TO LAND DUE TO DIVERSION OF STREAM).
72 NYS 2d 209-219 (Ct Cl 1947).

Descriptors: *New York, *Alteration of flow, *Diversion, *Channel improvement, Dredging, Damages, Judicial decisions, State governments, Riparian rights, Streamflow, Natural flow, Riparian land, Erosion, Soil erosion, Flood damage, Nonnavigable waters, Eminent domain, Legal aspects, Compensation.

efendant state, in connection with the construction of a bridge over a creek, dredged the bed of the creek on claimant's farm. This action changed the course and channel of the creek and diverted the flow of the stream causing the top soil from part of the farm to be washed away. The dredging was done without the claimant's permission. Claimants brought suit, alleging negligence by the state in changing the channel, and praying for compensation for the appropriation of their land by the state. The state contended that the allegations failed to state a cause of action. The court held that the state was negligent and the trespass on claimant's land to dredge the creek created a wrongful condition which constituted a continuing trespass. Where real estate is actually invaded by superinduced additions of water so as to destroy or impair its usefulness, there is a taking within the meaning of the Constitution for which compensation must be made. (Heckerling-Fla)
W69-05560

CORNETT V HEBERT (OBSTRUCTION TO FLOW OF SURFACE WATER).
31 So 2d 446-450 (Ct App La 1947).

Descriptors: *Louisiana, *Easements, *Drainage, *Dams, Natural flow, Alteration of flow, Obstruction to flow, Relative rights, Legal aspects, Right-of-way, Culverts, Canals, Ditches, Drainage water, Drainage effects, Surface waters, Developed waters, Damages, Drainage practices, Irrigation, Judicial decisions.
Identifiers: Equitable servitudes.

Plaintiff brought suit praying that defendant be ordered to remove a dam or obstruction which he constructed on his own property at a point where a large culvert, situated underneath an irrigation ditch, carried drainage water from plaintiff's property. The property of the parties was contiguous. Plaintiff's property was higher than the defendant's and the natural flow of water was onto defendant's land. The dam set up by defendant impeded that natural drainage. The ditch was dug over twenty years prior to the commencement of this action on plaintiff's land. Plaintiff alleges that, even if the drainage is not a natural flow, a servitude has been acquired by him and defendant may not now construct the dam. The court held that defendant owed plaintiff a servitude of drainage because the natural flow was from plaintiff's land to defendant's land. Plaintiff was also entitled to recover for damage to the grass which he had planted on his land and which was injured by ponding caused by the maintenance of the dam. (Heckerling-Fla)
W69-05562

BRAY V CITY OF WINTER GARDEN (SURFACE WATERS CAST ON LOWER PROPERTY).

40 So 2d 459-462 (Fla 1949).

Descriptors: *Florida, *Reasonable use, *Drainage, *Alteration of flow, Judicial decisions, Damages, Cities, Riparian rights, Relative rights, Water pollution, Surface waters, Culverts, Sewers, Ditches, Canals, Waste disposal, Waste water disposal, Industrial wastes, Natural streams, Legal aspects.
Identifiers: Injunctions (Prohibitory).

Plaintiffs brought this suit to enjoin the discharge of surface waters upon their lands and to collect for the damage they had suffered. Plaintiffs alleged that the defendant municipality maintained a system of culverts, sewers, ditches, and canals for the collection and disposal of surface waters, and charged that the city not only permitted water to accumulate in such quantities that when discharged it inundated their lands, but also that it permitted individuals and corporations to use the conduits for discharge of industrial waste. The question in the trial court was whether, under the facts in the case, the lower property owned by plaintiffs, which was planted in citrus trees, was rendered useless because the city (1) unlawfully overtaxed the natural watercourse and (2) allowed the waters to become contaminated by the discharge of industrial waste. The court affirmed the chancellor's decisions, holding that defendant was not chargeable

with any overflow which had resulted from its drainage system. There had been no unreasonable use of the watercourse and thus, no damage for which the city could be held accountable. (Heckerling-Fla)
W69-05563

MORRIS V WINTERS (ACTION TO REMOVE AN OBSTRUCTION TO WATER FLOW).

35 Delaware County Reports 5-7 (C P Pa 1947).

Descriptors: *Obstruction to flow, *Easements, *Surface water, *Pennsylvania, Flooding, Judicial decisions, Real property, Natural flow, Watercourses, Discharge, Drainage, Legal aspects.
Identifiers: Equity, Injunctions (Mandatory).

Both plaintiff and defendants received title to their respective properties from a common grantor. There was an eight-foot driveway between the two properties which the deeds reserved to the property owners as a common 'automobile driveway, passageway and watercourse.' Defendants erected a three-inch curbing along their side of the driveway which blocked and dammed up the natural watercourse from plaintiff's to defendants' properties, causing the water to back up on plaintiff's property. Plaintiff asked that defendants be restrained from maintaining the curb. The court stated that an easement naturally exists for the discharge of surface water from property at a higher level across adjacent property at a lower level. Since the deed made the driveway a watercourse, defendant can do nothing to stop the natural drainage. The court held that the curb must be removed. (Childs-Fla)
W69-05567

LEIPER V HEYWOOD-HALL CONSTR CO (CLAIM OF ARTIFICIALLY INCREASED DRAINAGE ON PART OF UPPER LANDOWNER).
For primary bibliographic entry see Field 06E.
W69-05568

BIBERMAN V FUNKHOUSER (UPPER LANDOWNER'S RIGHT TO HAVE SURFACE WATER DRAIN UPON LOWER LANDOWNER).
For primary bibliographic entry see Field 06E.
W69-05570

UNITED STATES V KANSAS CITY LIFE INSURANCE CO (FLOODING, UNDERFLOWING).

339 U S 799-815 (1950).

Descriptors: *Missouri, *Mississippi River, *Underflow, *Percolation, Runoff, Drainage, Surface waters, Streams, United States, Federal government, Flooding, Ditches, Dams, Water level fluctuations, High water mark, Beds, Boundaries (Property), Real property, Easements, Navigable waters, Riparian rights, Riparian lands, Judicial decisions, Legal aspects.
Identifiers: Servitudes.

Respondent owned farm land abutting a nonnavigable tributary of a navigable river. The United States, in the interest of navigation, constructed a dam which caused the waters of the river to be maintained at the ordinary high water level. Respondent alleged that maintenance of the river at such a level obstructed the drainage of surface water from his lands and rendered such lands unusable for agricultural purposes. The government contended that the navigation servitude extended beyond the bed of the river to the Respondent's property and, therefore, that recovery should be denied. The court held that the navigation servitude possessed by the government extended only to the limit of the stream bed as delineated by the ordinary high water mark. The court further stated that the obstruction of the natural surface flowage from respondent's lands due to super saturation or underflowing of respondent's land was a taking of property for which compensation must be given. (Katz-Fla)
W69-05572

OSTLUND V STEARNS COUNTY (ARTIFICIAL ACCUMULATION OF SURFACE WATERS).
For primary bibliographic entry see Field 06E.
W69-05577

EARLY V SOUTH CAROLINA PUBLIC SERVICE AUTHORITY (CONSTRUCTION OF DAM AND DIVERSION OF RIVER).

90 SE 2d 472-481 (S C 1955).

Descriptors: *South Carolina, *Diversion dams, *Alteration of flow, *Public works, Damages, Judicial decisions, Rivers, Eminent domain, Navigable rivers, Non-navigable waters, Diversion structures, Salt water, Encroachment, High water mark, Fresh water, Hydroelectric plants, Water control, Dams.

Respondents brought this action for damages to their land resulting from the construction of a dam across the river which flowed past this land. The dam diverted a large part of the flow of fresh water to another stream. This diversion caused salt water from the ocean to invade the river and its tributaries which, at abnormal high tides, resulted in the spreading of salt over the land. It was contended that such action amounted to a taking of property for public use entitling them to just compensation under the provisions of the state constitution. Appellant admitted the construction of the dam and the diversion of the water but denied that there had been damage to any of respondents' land. It also contended that it was acting as a state agency exercising a sovereign power to improve navigation and that respondents' property was subject to navigation servitude. The court held that the acts of appellant constituted a taking of respondents' property within the purview of the state constitutional provision and that the damage award was supported by the evidence. (Heckerling-Fla)
W69-05578

EAVES V CITY OF OTTUMWA (LIABILITY FOR FLOOD DAMAGE).
For primary bibliographic entry see Field 06E.
W69-05587

CARLSON V A AND P CORRUGATED BOX CORP (FLOODING CAUSED BY NEGLIGENT MAINTENANCE OF DAM).
364 Pa 216, 72 A 2d 290-294 (1950).

Descriptors: *Pennsylvania, *Dams, *Flash floods, *Dam failure, Spillways, Embankments, Disasters, Rupturing (Dam failure), Overflow, Retaining walls, Damages (Storms), Cloudbursts, Backwater, Judicial decisions, Precipitation excess, Legal aspects.
Identifiers: *Acts-of-God, Proximate cause.

Plaintiffs brought this action for flood damage allegedly caused by defendant's negligence in failing to properly maintain its dam. On the night of the flooding, a heavy rain began and continued during the following day. The evidence adduced tended to show that negligent maintenance of the dam caused it to burst during the rainstorm, precipitating general flooding and specific damage to plaintiffs' properties. The court held that the fact that some other cause concurred with the negligence of defendant did not relieve defendant of liability unless he could show that such other cause would have produced the injury notwithstanding his own negligence. It is a familiar legal doctrine that where two tortfeasors are guilty of concurrent negligence, each is responsible for the full amount of the resulting damage and is not entitled to any apportionment of liability. There was no reason why the same rule should not apply where one of the operative agencies was a force of nature. Therefore, the court held defendant liable for the total damage caused by the flood, notwithstanding the face that a rainstorm caused the waters of the stream to rise. (Reed-Fla)
W69-05588

IODICE V STATE (DUTIES OF DAM OWNERS).
For primary bibliographic entry see Field 06E.
W69-05589

GOLDEN V AMORY (LIABILITY FOR FLOODING).
For primary bibliographic entry see Field 06E.
W69-05590

BLACK RIVER REGULATING DIST. V ADIRONDACK LEAGUE CLUB (CONDEMNATION PROCEEDINGS).
For primary bibliographic entry see Field 06E.
W69-05591

TAYLOR V STATE (PRESCRIPTIVE RIGHT TO FLOOD LAND).
For primary bibliographic entry see Field 06E.
W69-05592

NIXON V WELCH (SURFACE DRAINAGE EASEMENTS).

24 NW 2d 476-481 (Iowa 1947).

Descriptors: *Iowa, *Surface drainage, *Easements, *Ditches, Judicial decisions, Surface runoff, Surface waters, Drainage districts, Drainage systems, Drainage, Culverts, Artificial watercourses, Prescriptive rights, Natural flow doctrine, Relative rights, Legal aspects, Local governments.
Identifiers: Injunctions (Mandatory), Dominant estate, Servient estate.

Plaintiffs owned land along the east side of a road, and defendants owned land along the west side. Surface water on certain portions of plaintiffs' land drained in a southwesterly direction, through a culvert under the road, and across an artificial ditch on defendants' land. In 1940, defendant county caused the road to be graded, and the culvert was removed. The drainage ditch across defendants' land became filled with soil by natural processes. Plaintiffs claimed an easement for the surface water drainage and sought to have the culvert restored and the ditch cleared of debris. Defendants contend that since plaintiffs' land is within a certain established drainage district he is deprived of the rights of free flowage of surface water as between dominant and servient estates. The court held that the mere fact that plaintiffs' land was situated in an established drainage district did not affect plaintiffs' rights. Plaintiffs were entitled to have the culvert restored and the ditch cleared at their own expense. Easement rights could be acquired by prescription even though the artificial ditch was not legally established. (Molica-Fla)
W69-05593

JONES V LUCAS (SURFACE DRAINAGE).

326 Mich 455, 40 NW 2d 220-225 (1949).

Descriptors: *Michigan, *Surface drainage, *Farm management, *Cranberries, Judicial decisions, Farms, Drainage water, Surface runoff, Drainage, Easements, Flooding, Natural flow, Legal aspects.
Identifiers: Injunctions (Prohibitory), Restrictive covenants, Equitable Servitudes.

Plaintiff and defendant purchased adjacent land from a common grantor. Defendant's deed made his land subservient to plaintiff's in regard to the flooding of plaintiff's land to achieve an adequate surface water level in which to grow cranberries. The natural flow of drainage was from defendant's

property to the land of plaintiff. Plaintiff sought an injunction to restrain defendant from draining his land since such drainage caused the water level on plaintiff's land to decrease. The court held that injunctive relief was proper in this case. Sufficient evidence had been adduced to show that, in making defendant's estate subservient to plaintiff's, the intent of the parties was to promote cranberry husbandry on plaintiff's land. (Molica-Fla)
W69-05594

STATE ROADS COMMISSION V BERRY (CONDEMNATION AWARDS).
For primary bibliographic entry see Field 06E.
W69-05596

TALBOT V KERN (SERVITUDES OF DRAINAGE).
For primary bibliographic entry see Field 06E.
W69-05597

BROWN V BLANKENSHIP (SUBSERVIENT DRAINAGE).
For primary bibliographic entry see Field 06E.
W69-05598

LEWALLEN V DAVENPORT (DAMAGE FROM BACKING SURFACE RUNOFF).

255 SW 2d 16-17 (Ky Ct App 1953).

Descriptors: *Kentucky, *Repulsion (Legal aspects), *Surface drainage, *Natural flow, Flood damage, Backwater, Damages, Earth dams, Overlying proprietor, Water law, Judicial decisions, Legal aspects, Surface runoff, Surface waters, Natural flow doctrine, Obstruction to flow, Drainage, Relative rights, Diversion structures.

Plaintiff owned land adjacent to a state highway. Defendant's land adjoined, at a lower elevation, plaintiff's lot. Reconstruction of the highway by the state caused water to drain over plaintiff's lot and onto defendant's land. To prevent water from flowing onto his land, defendant created a dirt fill which caused water to back onto plaintiff's land. Plaintiff brought this action to recover for flood damage to his grist mill. The trial court directed a verdict for the plaintiff, ruling that defendant's possible claim against the Commonwealth was no defense. The appellate court affirmed, holding that a landowner has no right to intentionally divert the natural flow of water to the injury of a neighbor on the ground that such diversion prevents damage to his land. The court found no merit in defendant's contention that plaintiff had no right to permit the state to shift drainage over his lot, nor in the argument that damage would have been minimized had the plaintiff moved or elevated the mill. (Wheeler-Fla)
W69-05600

4B. Groundwater Management

PUTTING WASTE WATER TO BENEFICIAL USE - THE FLUSHING MEADOWS PROJECT,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
For primary bibliographic entry see Field 05D.
W69-05327

RETURNING WASTES TO THE LAND, A NEW ROLE FOR AGRICULTURE,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
For primary bibliographic entry see Field 05D.
W69-05328

UNPROTECTED WELLS.
For primary bibliographic entry see Field 06E.
W69-05367

4C. Effects on Water of Man's Non-Water Activities

WETLANDS (CONTROL AND REGULATION IN MAINE).
For primary bibliographic entry see Field 06E.
W69-05366

MALICIOUS MISCHIEFS-PUBLIC UTILITIES.

Me Rev Stat Ann tit 17, secs 2351-2353 (1965).

Descriptors: *Maine, *Utilities, *Electricity, *Water works, State governments, Legislation, Legal aspects, Cities, Electrical equipment, Artificial watercourses, Docks, Piers, Pipelines, Reservoirs, Dams, Fish passages, Canals, Mills.

Section one imposes a punishment of a fine not more than $1000 or imprisonment for not more than 3 years for the willful or malicious destruction, removal, etc., of wharfs, piers, docks, pipelines, reservoirs, dams, fishways, canals, etc. The second specifies the punishments for the unlawful and intentional tapping of water pipes or fixtures belonging to any water company, city or water district. Section three applies to the unlawful and intentional destruction or injury to apparatus belonging to gas or electric companies; the tampering with gas, water or electric meters so as to alter their registration of amount supplied; and, the tampering or interference with pipes of fixtures of these companies. Sections two and three carry a possible fine of not more than $100 or imprisonment for not more than 11 months, or both. (Logan-Fla)
W69-05374

HIGHWAYS.
Mich Comp Laws Ann, secs 230.4, 235.1-235.8a (1967).

Descriptors: *Michigan, *Highways, *Legislation, *Local governments, Legal aspects, Cities, Drainage, Right-of-way, Drainage systems, Drainage programs, Drains, Culverts, Bridges, Cost sharing, Cost allocation, Obstruction to flow, Navigable waters, Streams, Administrative agencies.
Identifiers: Penalties (Civil).

Obstruction of the navigation of any stream declared to be a public highway or obstruction of highway drainage ditches by diversion or blockage carries a maximum penalty of $25. The county drain commissioner may lay drains along public highways after obtaining a release from the owners of the land involved and compensating them therefore. A bridge or culvert used to accommodate a drain which crosses a highway must be of a permanent nature and able to sustain a 15 ton moving load. The cost of construction shall be born according to the nature of the highway. The consent of the highway commissioner of a township, in which an open drain is to be laid along the highway, is necessary prior to construction. The cost of such drain shall be apportioned by the county drain commission among those benefited. When necessary the highway commission may secure the right of way to drain water across land adjacent to the highway. The purchase price must be approved by the township board. The highway commission shall make an annual report to the electors of the township. (Molica-Fla)
W69-05378

HIGHWAYS.

Mich Comp Laws Ann, secs 254.5, 254.22, 254.25-254.32 (1967).

Descriptors: *Michigan, *Legislation, *Highways, *Local governments, Bridges, Culverts, Bridge construction, Navigable waters, Obstruction to flow, Costs, Reimbursable costs, Alteration of flow, Navigation, Streams, Ships, Channels, Permits, Boundaries (Surfaces), Administrative agencies.

Commissioners in charge of construction or maintenance of bridges or culverts may provide for the removal of any booms, rafts, logs, etc., when such are a menace to its construction or maintenance. Failure to comply with the commissioner's order of removal is a misdemeanor. Bridges or culverts across navigable streams must not interfere with the navigation of the stream or logs floating therein and must afford reasonable passage for vessels and timber. No one may alter the stage of water or the channel of any watercourse before securing a written permit from the commissioners having jurisdiction over all the bridges and culverts or the watercourse affected. One obtaining a permit is liable for all of the expenses resulting from bridge and bridge approach work made necessary by the alteration and the maintenance thereof as determined by the commissioners. Anyone owning a water work having a race crossing a public highway must maintain a sufficient bridge or culvert across the same. This act does not apply to any bridge across any river forming the boundary between Michigan and a foreign country. (F. Molica-Fla)
W69-05379

STATE SQUIRE V CITY OF CLEVELAND (FILL LAND AND HIGHWAY USE AS TO LITTORAL RIGHTS).
74 NE 2d 438-459 (Ohio Ct App 1947).

Descriptors: *Ohio, *Access routes, *Riparian rights, *Riparian lands, Legislation, Cities, Highways, Landfills, Beds, Lakes, Lake Erie, Great Lakes, Reasonable use, Condemnation, Eminent domain, Public benefits, Public rights, Public lands, Legal aspects, Judicial decisions, Littoral, Navigation, Piers.
Identifiers: State statutes.

Plaintiff sought a declaratory judgment concerning the rights of the parties in certain landfills adjacent to plaintiff's littoral lands. The plaintiff also sought to enjoin defendant from maintaining a thoroughfare over the landfill. The defendant contended that its activities were sanctioned by state statute authorizing cities to construct marginal thoroughfares along the shoreline and across landfills along Lake Erie. The plaintiff argued that part of the enabling statute relied on by the defendant was unconstitutional in regard to certain issues not at bar. The plaintiff contended that the entire statute was void due to the invalidity of that section. The court upheld the statute despite partial invalidity. Plaintiff contended that defendant was not conforming to the statutory requirement that the thoroughfare be utilized for purposes of commerce and navigation. The court held that the highway regulation forbidding truck travel was therefore illegal, but denied plaintiffs further contention that their littoral rights to wharf out into navigable water had been violated, recognizing that plaintiffs could retain access to such water by construction of overpasses and underpasses. (Katz-Fla)
W69-05555

DEYO V ATHOL HOUSING AUTHORITY (DAMAGE FROM WATER DISCHARGE).

140 NE 2d 393-395 (Mass 1957).

Descriptors: *Repulsion (Legal aspects), *Drainage water, *Local governments, Surface waters, Water law, Water rights, Drainage, Obstruction to flow, Water control, Flow control, Pipelines, Sewers, Subsurface water, Subsurface drainage, Water table, Public lands, Road construction roadbanks, Basins, Flow resistance.

Plaintiff sued the own of Athol and the Athol Housing Authority for property damage caused by water discharge from adjoining lands. The discharge was allegedly caused by defendant's activities in installing drainage trenches and pipelines during con-

struction of a road. While the court conceded that some of the damage was caused by the activities of defendant, it also found that part of the damage was caused by the natural accumulation of water on plaintiff's land. Drainage of the accumulated water was impeded by the presence of the road. On the principle that the obstruction of surface water flow affords no cause of action by a person who suffers loss therefrom against one who does no act inconsistent with the due exercise of dominion over his own soil, the supreme court held that defendants could not be held liable for the damage caused by the maintenance of this obstruction absent a finding of a right in the plaintiffs to drain over the land where the road was maintained. (Carruthers-Fla)
W69-05556

CRANCE V STATE (DAMAGES FOR APPROPRIATION OF RIPARIAN RIGHTS BY THE STATE).
For primary bibliographic entry see Field 06E.
W69-05580

4D. Watershed Protection

TILLAGE METHODS TO REDUCE RUNOFF AND EROSION IN THE CORN BELT,
Agricultural Research Service, Washington, D. C.; Purdue Univ., Lafayette, Ind. Agricultural Experiment Station.
For primary bibliographic entry see Field 03F.
W69-05330

ENGINEERING TECHNIQUES AND PRINCIPLES APPLIED TO SOIL EROSION CONTROL,
Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.
Burchard H. Heede.
Forest Service USDA, Research Note RM-102, pp 1-7, 1968. 7 p, 2 photo, 11 ref.

Descriptors: Soil erosion, *Soil stabilization, *Grassed waterways, Watershed management, *Erosion control, Cultivated lands, Dams, Vegetation establishment, *Check structures, *Hydraulic engineering, Land reclamation.
Identifiers: *Italian hydraulic reclamation.

Two basic approaches to erosion control are (1) resisting natural forces, and (2) utilizing them. Examples of (1) are check dams and grassed waterways; of (2), Italian hydraulic reclamation where erosive forces are used to stabilize watersheds. Objective of both is to establish a vegetation cover.
W69-05333

LEGAL ASPECTS OF THE SMALL WATERSHED PROGRAM IN IOWA,
Iowa Univ., Iowa City. Agricultural Law Center.
Charles Campbell, William N. Hines, and Marshall Harris.
Legal Aspects of the Small Watershed Program in Iowa, Sept 1965. 37 p, 135 ref.

Descriptors: *Iowa, *Watersheds, *Watershed management, *Watershed protection and flood prevention act, Legal aspects, Floods, Water resources, Water conservation, Flood control, Small watersheds, Forest management, Navigable streams, Soil conservation, Natural resources, Rivers, Legislation, River basin development, Reservoirs, Beneficial use, Wildlife, Recreation, Erosion.
Identifiers: *Soil conservation district, Department of Agriculture, Agricultural Conservation Program, Army Corp of Engineers, Potomac River.

The authors first discuss the historical aspects of the problem, of watershed development primarily with federal governmental activity in this area. The various Flood Control Acts are employed as a method of structuring the discussion of watersheds. This leads to a more concentrated study of the problems and developments in Iowa water law. A detailed treatment of the Iowa situation is pursued. The organization and financing of the Small Watershed Project in Iowa is discussed in depth. The system for applying for watershed projects in various communities is considered. The authors enumerate the powers they consider necessary for success of the project and discuss the problems inherent in such an undertaking. Detailed recommendations are also included in an effort to outline a workable and effective method of watershed development. (Shevin-Fla)
W69-05339

DELAWARE RIVER BASIN COMPACT.

N J Stat Ann secs 32:11D-38 to 32:11D-110 (1963); N J Stat Ann secs 32:11D-111 to 32:11D-115 (Supp 1968-69).

Descriptors: *Watershed management, *Hydroelectric power, *Financing, Interstate compacts, Withdrawal, Delaware River Basin Commission, Interstate rivers, Projects, Erosion control, Runoff, Soil management, Forest management, Wildlife management, Recreation, Recreation facilities, Administration, Dams, Transmission (Electrical), Diversion, Water shortage, Permits, Regulation, Capital.
Identifiers: Intergovernmental relations, Comprehensive plan, Delaware River Basin Compact.

The Delaware River Basin Commission is to promote sound practices of watershed management in the basin, including projects and facilities to retard runoff and water flow and prevent soil erosion. The Commission is to provide for the development of water related public sports and recreational facilities. The waters of the Delaware River and its tributaries may be impounded and used by or under authority of the Commission for the generation of hydroelectric power. The Commission may regulate and control withdrawals and diversions from surface and ground waters of the basin. Various rules are established for the purpose of avoiding conflicts of jurisdiction. The procedures and limits for capital financing are provided. The Commission is to adopt, and may review and revise, a comprehensive plan for the immediate and long range development and use of the water resources of the basin. The Commission shall annually adopt a water resources program based upon the comprehensive plan. The Commission has the power of condemnation to accomplish the purposes of the compact. (Childs-Fla)
W69-05345

DICKSON V BOARD OF COMM'RS OF CADDO LEVEE (EXPROPRIATION OF RIPARIAN LAND BY THE STATE).
For primary bibliographic entry see Field 06E.
W69-05585

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

OIL SPILLAGE STUDY, LITERATURE SEARCH, AND CRITICAL EVALUATION FOR SELECTION OF PROMISING TECHNIQUES TO CONTROL AND PREVENT DAMAGE,
Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.
For primary bibliographic entry see Field 05G.
W69-05262

DETERMINATION OF ORGANOCHLORINE INSECTICIDES IN SOILS AND WATERS,
Wisconsin Univ., Madison. Dept. of Soils; Agricultural Research Service, Washington, D. C.
H. B. Pionke, and G. Chesters.
Soil Sci Soc America Proceedings, Vol 32, No 6, pp 749-759, Nov-Dec 1968. 10 p, 82 refs. OWRR Project B-016-WIS.

Descriptors: *Analytical techniques, *Organochloride insecticides, *Application methods, Column chromatography, Thin-layer chromatography, Gas liquid chromatographic techniques.
Identifiers: *Soil, *Water, Methods of equilibrating.

Pertinent references on the determination of organochloride insecticides in soil and water samples are reviewed. The particular methods are chosen because of their applicability to heterogeneous systems which often provide problems due to coextraction of indigenous components. The review is divided into three principal sections, i.e., extraction of organochlorine insecticides from soils and waters, cleanup of soil and water extracts, and analysis of purified soils and water extracts. Criteria used in evaluating extraction procedures were based on methods of equilibrating the insecticide with the soil sample and the control of possible insecticide losses through degradation and volatilization. A large portion of the methods of final analysis of purified extracts is given over to gas-liquid chromatographic techniques. The gas-liquid chromatographic methods are discussed on the basis of peak resolution, detection and measurement of the insecticides, and confirmation of their identity. Thin-layer chromatographic, spectrophotometric, and other methods of determination of organochlorine insecticides in purified extracts are evaluated.
W69-05325

COMPONENTS OF WOOD PULP BLEACH EFFLUENTS,
Pulp Manufacturers Research League, Inc., Appleton, Wis.
J. W. Collins, A. A. Webb, H. P. Didwania, and B. F. Lueck.
Environ Sci and Technol, Vol 3, No 4, pp 371-377, Apr 1969. 7 p, 10 fig, 3 tab, 17 ref.

Descriptors: *Water pollution sources, *Pulp wastes, Sulfite liquors, Phenols, Biochemical oxygen demand, Cellulose, Lignins, Organic wastes, Pulp and paper industry, Analytical techniques, Chromatography, Spectrophotometry.
Identifiers: Kraft pulp waste, Pulp-bleaching wastes, Sulfite wastes, Gel chromatography, Catechols.

Chlorination and alkaline extraction bleach effluents from a sulfite and a kraft wood pulp mill were concentrated by reverse osmosis and their dominating chemical properties investigated. The solids were high in ash and the organic residues were highly colored. Biological oxygen demand was found to be due to relatively high molecular weight species as well as to low molecular species. The ultraviolet spectra and ionization difference spectra of the effluents and fractions obtained by gel chromatography on two Sephadex gels in series are presented. Some of the ionization difference spectra were lower in intensity than expected for alkaline extraction products of chlorinated lignin. Other spectra suggested that much of the color in a kraft chlorination effluent was of carbohydrate origin. Catechol groups were found to be stable end-products of a sulfite pulp chlorination. (Knapp-USGS)
W69-05402

DEVELOPMENT OF BIOLOGICAL INDICES TO POLLUTION LEVELS IN STREAMS AFFECTED BY ACID MINE DRAINAGE AND OIL FIELD BRINE WASTES,
Ohio State Univ., Columbus.
Charles A. Dambach, and John H. Olive.
Ohio State Univ Water Resources Res Center Proj 103 Completion Rep, Feb 1969. 90 p, 14 fig, 17 tab, 68 ref. OWRR Project A-003-OHIO.

Descriptors: *Pollutant identification, *Bioindicators, *Acid mine water, *Brines, *Water pollution effects, Aquatic life, Morbidity, Toxicity, Fouling, Phytotoxicity, Analytical techniques, Bioassay, Mayflies, Midges, Bacteria, Water quality, Ohio.
Identifiers: Biological pollution indices, Acid mine drainage, Oilfield wastes.

Biological criteria are presented for use in setting water quality standards to assure desirable levels of aquatic life in streams. Stream monitoring devices for water quality parameters critical to aquatic life are available but not in sufficient numbers. Quantitative and qualitative studies of aquatic organisms may be used to measure these parameters because many organisms are sensitive to variation in the important environmental conditions to be monitored. For examples, mayflies appear in abundance only where oxygen availability is continuously high, and some midges appear only with nearly anaerobic conditions. The biocommunity structure of polluted streams was studied in Raccoon Creek in SE Ohio and in 2 headwater tributaries of the Scioto River in central Ohio. Benthic macroinvertebrate and algal communities are described in terms of the relative abundance of organisms and the species diversity index of Wilm and Dorris. An inventory of collected organisms is included. The biological data are related to the physico-chemical character of each stream. (Knapp-USGS)
W69-05407

WATER QUALITY INVESTIGATION, PART 1 - BASIC DATA, FORT LOUDOUN RESERVOIR, APRIL 1966 - JUNE 1968,
Tennessee Univ., Knoxville. Dept. of Sanitary Engineering.
F. C. Larson.
Tenn Water Resources Res Center Tech Bull No 1, Aug 1968. 85 p, 1 fig, 2 tab. OWRR Project A-006-TENN.

Descriptors: *Data collections, *Water quality, *Reservoirs, *Tennessee River, *Tennessee, Temperature, Dissolved oxygen, Biochemical oxygen demand, Hydrogen ion concentration, Conductivity, Color, Suspended load, Coliforms.
Identifiers: *Fort Loudoun Reservoir (Tenn), Apparent color, Centrifuged color.

Data are compiled for use in study of the relationships of water quality parameters in a reservoir during controlled discharges. Fort Loudoun Reservoir on the Tennessee River is about 55 mi long and has a capacity of about 386,000 acre-ft. The water is used for public supply, recreation, commercial fishing, navigation, stock water, irrigation, and power production. Samples were taken from the top, middle, and bottom of the reservoir at 10 cross sections shown on a map. The tabulated data include temperature, dissolved oxygen, biochemical oxygen demand, pH, conductivity, apparent color, centrifuged color, suspended solids, and coliforms. (Knapp-USGS)
W69-05416

IDENTIFICATION AND DIFFERENTIATION OF HEAVY RESIDUAL OIL AND ASPHALT POLLUTANTS IN SURFACE WATERS BY COMPARATIVE RATIOS OF INFRARED ABSORBANCES,
Federal Water Pollution Control Administration, Cincinnati, Ohio.
Fred K. Kawahara.
Environ Sci and Tech, Vol 3, No 2, pp 150-153, Feb 1969. 4 p, 4 fig, 4 tab, 10 ref.

Descriptors: *Oily water, *Analytical techniques, *Water pollution sources, *Asphalt, Oil-water interface, Lake Michigan, Spectrophotometry, Absorption, Infrared radiation, Surface waters, Taste, Odor, Oil wastes.
Identifiers: *Petroleum products, Oil spills, Autoxidation.

To determine the chemical nature of the heavy petroleum products in the 1967 Lake Michigan oil spill, a procedure for characterization and identification of the tarlike materials was needed. Samples from beach water were analyzed by infrared spectrophotometry. The unknown spectra would not match the known spectra, since autoxidation caused changes in the unknown specimen. By comparative ratios of infrared absorbances, the identity of the critical unknown samples was established. Although asphalt and heavy residual oil have similar infrared spectra, there is a sharp distinction between them. Samples from 7 companies were tested, using the new method for rapid identification and for distinguishing the 2 types of petroleum products which can coexist in surface waters as pollutants. (Lang-USGS)
W69-05421

PREDICTING TEMPERATURES OF SMALL STREAMS,
Oregon State Univ., Corvallis. Forest Research Lab.
For primary bibliographic entry see Field 02E.
W69-05427

RESERVOIR FISHERY RESOURCES,
American Fisheries Society, New York.
For primary bibliographic entry see Field 02H.
W69-05463

5B. Sources of Pollution

SOURCES OF COAL MINE DRAINAGE POLLUTION, WHEELING CREEK WATERSHED, OHIO.
Federal Water Pollution Control Administration, Wheeling, W. Va. Ohio Basin Region.

Fed Water Pollut Contr Admin, Mine Drainage Unit Work Doc No 25, June 1968. 22 p, 2 fig, 4 tab, 1 append.

Descriptors: *Acid mine water, *Coal mines, *Water pollution, *Ohio, Iron, Sulfates, Turbidity, Water quality, Strip mines.
Identifiers: Wheeling Creek (Ohio), Bituminous coal mines.

Field studies of stream quality and sources of mine drainage were made in the Wheeling Creek watershed (108 sq mi). The area, mined for bituminous coal for 150 yr. left hundreds of underground voids and large surface-mined areas capable of producing acidic and mineralized drainage. Part of nearly every tributary to the main stream is affected by mine discharges of excessive dissolved iron, sulfate, hardness, and total mineralization. Precipitation of iron compounds, particularly in Wheeling Creek, causes additional problems of high turbidity and unsightly stream conditions. Some 160 mine sites and an estimated 12,000 acres of strip-mined area were investigated. Samples were collected from 120 drainage sources; 72 were discharging at the time. Discharges from the coal mine sources ranged from 1 to 306 gpm and totalled 2.1 million gpd. The pH values ranged from 2.3 to 8.4 and acidity concentrations from 0 mg/1 to 20,950 mg/1. Active mining operations contributed only a small percentage of the total discharge volume and chemical loadings. Strip mines and mine refuse areas contributed equally small percentages of the total. Inactive or abandoned underground (drift) mines are the principal drainage pollution sources in Wheeling Creek. Fifteen principal mine drainage sources were found to contribute 72% of the sulfate loading and nearly 40% of the iron loading discharged to the streams. Physical abatement of these principal sources and at least 1/2 of all sources would improve water quality in Wheeling Creek to a tolerable level. (Lang-USGS)
W69-05202

OIL SPILLAGE STUDY, LITERATURE SEARCH, AND CRITICAL EVALUATION FOR SELECTION OF PROMISING TECHNIQUES TO CONTROL AND PREVENT DAMAGE,
Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.
For primary bibliographic entry see Field 05G.
W69-05262

NITROGEN CYCLE IN SURFACE AND SUBSURFACE WATERS,
Wisconsin Univ., Madison.
S. Witzel, E. McCoy, O. J. Attoe, L. B. Polkowski, and K. T. Crabtree.
Water Resources Center, Univ., of Wisconsin, Technical Completion Report, December 1968. 65 p, 15 tab, 12 fig, 27 ref. OWRR Project B-004-WIS.

Descriptors: *Domestic animals, *Wastes, Fertilizers, *Essential nutrients, *Nitrification, Crops, Toxicity, Soil porosity, Irrigation, Ground water, Runoff, Frozen ground, Soil erosion, Water pollution, *Denitrification, Phosphorus compounds, Algae, Aquatic plants.
Identifiers: *Nitrogen Cycle, *Farm waste, Ground water, *Nitrates, Eutrophication, *Water pollution sources, Agricultural watersheds.

Autotrophic and heterotrophic nitrification have been studied with 191 samples of shallow water from streams, farm ponds and adjacent soils. Of 47 chosen for repeated tests, 45 produced NO sub 2-N ranging 5-154 microgram/ml, av. 48 microgram/ml. Only 2 produced NO sub 3-N at 33 and 46 microgram/ml. Of 167 stock cultures of soil fungi, the main producers were in the Aspergillus flavus-oryzae and A. wentii groups (75% yielded 65-100 microgram/ml of NO sub 3-N) and the Penicillium genus (21 of 24 species yielded 7-19 microgram/ml of NO sub 3-N from NO sub 2-N, not from organic N). Nitrifiers of NO sub 2, NO sub 3 type were found in 5 other genera. Residual NO sub 3 following crop maturity migrates downward from 12 inches to aquifer depth at 20 feet over winter on Waupun and Plainfield soils, respectively. One Wisconsin community had 86 wells with 34.5% unsafe containing high NO sub 3 and another had 550 wells with 1/3 unsafe. Surface waters received less than 5.7 lb. N and 2.53 lb. P per A. in flood flows from a 1346 A. watershed; 3.62 lb. N and 1.14 lb. P per A. from 3 farm areas totaling 246 A. Lancaster plots receiving 15 tons dairy cow wastes per A. lost 19.8% more N and 11.3% more P when applied on frozen ground in a year of high winter runoff.
W69-05323

UNWHOLESOME PREMISES; REMOVAL AND REHABILITATION AT OWNER'S EXPENSE.

Mich Comp Laws Ann secs 67.49-67.50 (1967).

Descriptors: *Michigan, *Legislation, *Local governments, *Stagnant water, Odor, Drains, Cities, Assessments, Abatement, Pollution abatement, Public health.

Village councils may rectify, or cause an owner, occupant, or person in charge to rectify any premises, cellar, vault, lot, drain, or place, which is unwholesome, damp, offensive, etc., or which is covered by stagnant or impure water or produces offensive exhalations. They may remove, or require the owner or occupant to remove any building, fence, or structure if it is ruinous or liable to cause injury to persons or property. If the owner or occupant of such lot or premises fails to abate a nuisance after notice by the council or board of health to do so, he is liable for the expenses incurred by the council in causing the same to be done. The expenses may be recovered as a special assessment on the premises or by court action. (F. Molica-Fla)
W69-05376

COMPONENTS OF WOOD PULP BLEACH EFFLUENTS,
Pulp Manufacturers Research League, Inc., Appleton, Wis.

or primary bibliographic entry see Field 05A.
/69-05402

EVELOPMENT OF BIOLOGICAL INDICES O POLLUTION LEVELS IN STREAMS AF-ECTED BY ACID MINE DRAINAGE AND OIL IELD BRINE WASTES,
hio State Univ., Columbus.
or primary bibliographic entry see Field 05A.
/69-05407

/ATER QUALITY INVESTIGATION, PART 1 - ASIC DATA, FORT LOUDOUN RESERVOIR, PRIL 1966 - JUNE 1968,
ennessee Univ., Knoxville. Dept. of Sanitary En-ineering.
or primary bibliographic entry see Field 05A.
/69-05416

DENTIFICATION AND DIFFERENTIATION F HEAVY RESIDUAL OIL AND ASPHALT OLLUTANTS IN SURFACE WATERS BY OMPARATIVE RATIOS OF INFRARED AB-ORBANCES,
ederal Water Pollution Control Administration, incinnati, Ohio.
or primary bibliographic entry see Field 05A.
/69-05421

HE LONGITUDINAL DIFFUSION COEFFI-IENT IN THE DELAWARE RIVER ESTUARY S DETERMINED FROM A STEADY-STATE IODEL,
eological Survey, Philadelphia, Pa.
or primary bibliographic entry see Field 02L.
/69-05428

HOSPHORUS IN FLOWING WATERS,
ederal Water Pollution Control Administration, incinnati, Ohio.
owell E. Keup.
/ater Res (Pergamon Press, Great Britain), Vol 2, p 373-386, 1968. 14 p, 2 fig, 1 tab, 48 ref.

escriptors: *Phosphorus compounds, *Surface aters, Groundwater, Water pollution sources, hemical wastes, Fertilizers, Percolation, utrients, Eutrophication, Biodegradation, Sedi-entation.
dentifiers: Phosphorus distribution (Surface aters).

he sources of phosphorus to flowing waters are eviewed on the basis of point of origin and quanti-es. Phosphorus within a stream is assimilated out f the flowing water mass. Biota is the principal gent of assimilation which occurs in both au-otrophic and saprophytic ecosystems. The rate onstant of assimilation can be estimated. After emoval from the flowing water, the phosphorus is emporarily stored in bottom deposits or trans-orted as a portion of the stream's bed-load. Long-erm storage is effected when the phosphorus is bu-ed in deltas, or deposited on flood plains. (Knapp-/SGS)
/69-05445

/ B RODDENBERY CO INC V CARTER DAMAGES FOR POLLUTION OF STREAM).

92 F 2d 448-451 (5th Cir 1952).

escriptors: *Georgia, *Water pollution, Damages, *Industrial plants, Pollution abatement, /ater pollution effects, Industrial wastes, Streams, easonable use, Riparian rights, Judicial decisions, /aste water disposal, Waste water (Pollution), Ci-es, Legal aspects.
dentifiers: Remittitur.

laintiff brought suit for damages to land and cattle esulting from the discharge of waste and refuse by efendant's plant into a stream flowing through laintiff's land. By arrangement between defendant pickle company and defendant city, waste from the pickle plant was dumped as sewage into the stream. This not only polluted the stream causing cattle who drank from it to die, but injured the lands bordering the stream. Plaintiff suffered permanent damages measured by the loss in the market value of the land. The defendants assigned as error the charge to the jury as to the measure of damages and the overruling of their objection to the introduction to certain evidence by plaintiffs. The court was of the opinion that the conduct of defendant in turning the refuse and waste into the creek was clearly wrongful and that, but for the errors complained of, a judgment for plaintiff would have been justified. The case ought not to be sent back for a new trial unless such disposition is clearly necessary to obtain substantial justice. Therefore, the court order remittitur of a portion of the damage award and affirmed the lower court. (Heckerling-Fla)
W69-05559

AMERICAN CYANAMID CO V COMMONWEALTH (POLLUTION ABATEMENT).
For primary bibliographic entry see Field 05G.
W69-05575

STATE V GLIDDEN CO (CONSTITUTIONALITY OF WATER POLLUTIONS CONTROL STATUTE).
For primary bibliographic entry see Field 05G.
W69-05586

5C. Effects of Pollution

WATER FOR LIVING,
World Health Organization, Geneva (Switzerland).
M. G. Candau.
For the 8 Volume Proceedings, see Vol 2, No 9, Field 06B and W69-03305. Int Conf on Water for Peace, Wash. D C, Vol 1, pp 85-89, 1968. 5 p.

Descriptors: *Public health, *Water supply, Waste disposal, Social aspects, Legal aspects, Water utilization, Water pollution effects, Water pollution control, Diseases.
Identifiers: World Health Organization, Water-borne diseases.

The objective of the World Health Organization as defined by its constitution is the attainment by all peoples of the highest possible level of health. Predominant among the environmental factors which impinge on public health is water. Cholera pandemics ravaged Asia, Europe and the American continent during the 19th century. In the last 5 years cholera has spread to countries which have not experienced this scourge for many years. In addition to cholera, typhoid and para-typhoid, bacillary and amoebic dysenteries and the diarrhoeal diseases, together are the leading causes of death and disability in the less developed areas of the world. Water plays an important role in the spread and control of these and other diseases. It has been estimated that there are 5,000,000 deaths and about 500,000,000 people sick from water-borne diseases each year. Expanding populations, increased industrialization, and the accelerated use of pesticides and herbicides have all had their influence upon natural bodies of water. Less than one-third of the urban dwellers in the world are being provided with piped water supplies in their houses and another third of the total of these city dwellers have no reasonable access to a safe water supply, or, indeed, to water in any reasonable quantity. The most important water-borne diseases are malaria, bilharziasis and filariasis. The proper design and management of water resources projects can usually minimize and often eliminate their effect. The World Health Organization has active programs of assistance to its Members for the control of water-borne and water-related diseases. (Knapp-USGS)
W69-05219

OIL SPILLAGE STUDY, LITERATURE SEARCH, AND CRITICAL EVALUATION FOR SELECTION OF PROMISING TECHNIQUES TO CONTROL AND PREVENT DAMAGE,
Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.
For primary bibliographic entry see Field 05G.
W69-05262

PESTICIDE LEVELS AND FLUCTUATION IN SOIL BACTERIA IN AN IRRIGATED FIELD AND A POND OF SOUTHWEST TEXAS,
Texas A and M Univ., College Station. Dept. of Plant Sciences.
Robert G. Taylor, and Howard G. Applegate.
The Southwestern Naturalist, Vol 13, No 4, pp 393-400, Dec 1968. 3 fig, 2 tab, 18 ref.

Descriptors: *Irrigated land, *Pesticide residues, *Soil bacteria, *Fluctuation, *Ponds, Texas, Stagnant water, Moisture availability, Bacteria, Irrigation water, DDT, Chlorinated Hydrocarbon pesticides, Cultivated lands, Turbidity, Silts, Pesticide drift.
Identifiers: Non-irrigated soils.

A study of pesticide effects on bacterial populations was conducted from June through August 1966 in a typical irrigated field in the Presidio area of Texas. Bacterial populations of field soil were directly correlated to the moisture of irrigation. Non-irrigated soil with adequate moisture for bacterial growth yielded an inverse relation between pesticide levels and bacterial numbers. It was suggested that from the data on non-irrigated soils that there was a connection between bacterial populations and breakdown of the chlorinated pesticide DDT. Adjacent to cultivated fields a stagnant body of water was examined for microbial numbers and pesticide levels. After each rainfall, when the pond was turbid and muddy from eroded bank soil, both bacterial numbers and pesticide levels rose. (Afleck-Ariz)
W69-05272

A LETHAL INDEX FOR CLASSIFYING CHEMICALS WHICH AFFECT WATER QUALITY OF AQUATIC LIFE,
Idaho Univ., Moscow. Water Resources Research Inst.
Craig MacPhee, and Dennis Norman.
Research Technical Completion Report, January 1969. 38 p, 2 tab, 4 fig, 31 ref. OWRR Project A-013-IDA.

Descriptors: Bioassay indicators, Water pollution, Toxicity, Fishkill, Water quality.

Seventeen toxic chemicals were bioassayed to investigate the possibility of measurable physiological responses to death in northern squawfish. Lethal indices, dependent upon concentration and temperature for each chemical, in terms of time between loss of equilibrium and death, were established. The physiological process of suffocation caused by the action of heavy metals and organic compounds of lactic acid, formaldehyde, and p-nitrophenol was identifiable and unaffected by concentration or temperature. The anesthetic effect of p-chlorophenol was discrete and also unaffected by concentration or temperature. The physiological actions of nitrites, other phenols, chlorinated hydrocarbons, and organophosphorus compounds were not discretely identifiable and the data indicate multiple physiological effects for these chemicals depending on concentration.
W69-05303

DEMONSTRATION OF A TOXIN FROM APHANIZOMENON FLOS-AQUAE (L.) RALFS,
New Hampshire Univ., Durham; National Marine Water Quality Lab., Kingston, R. I.
Philip J. Sawyer, John H. Gentile, and John J. Sasner, Jr.
Canadian Journal of Microbiology, Vol 14, No 11, pp 1199-1204, 1968. 7 p, 1 tab, 4 fig, 23 ref. OWRR Project A-013-NH.

Descriptors: Cyanaphyta, Algal control, *Algal toxins membrane, Northeast U.S.
Identifiers: Aquatic algae, Water pollution, *Toxicity, Biological membranes, Humid area.

A potent toxin was extracted from a natural population of the blue-green alga, Aphanizomenon flos-aquae. The toxin is thermo- and acid-stable; alkaline labile; soluble in water and ethanol; insoluble in acetone, ether, and chloroform; and readily dialyzable. Preliminary studies show that the alga contains a toxin which, when released from lysed cells, operates at the membrane level, destroying excitability without alteration of the transmembrane resting potential.
W69-05306

IDENTIFICATION OF ZOOGLOEA SPECIES AND THE RELATIONSHIP TO ZOOGLOEAL MATRIX AND FLOC FORMATION,
Ohio State Univ., Columbus.
B. A. Friedman, and P. R. Dugan.
Jour. Bacteriol. Vol 95, pp 1903-1909, May 1968. 7 p, 2 fig, 3 tab, 17 ref.

Descriptors: *Zoogloea bacteria, Zoogloea matrix, Gelatinous matrix, Bacterial flocculation, Zoogloea identification.
Identifiers: Bacteria zoogloea, *Zoogloeal matrix, Flocculation, Matrix gelatinous, *Floc formation.

Three floc-forming, gram-negative, polarly flagellated rods were isolated and characterized. These isolates were compared to four similar floc-forming organisms previously isolated in another laboratory and classified as two species of Zoogloea, one of Pseudomonas, and as one unidentified gram-negative rod. Possession of zoogloeal matrix or flocculent growth habit was examined in relation to growth and biochemical patterns of the bacteria. A possible relationship of Zoogloea to other gelatinous matrix-producing bacteria is discussed.
W69-05313

THE MICROBIAL FLORA OF ACID MINE WATER AND ITS RELATIONSHIP TO FORMATION AND REMOVAL OF ACID,
Ohio State Univ., Columbus. Water Resources Center.
For primary bibliographic entry see Field 05G.
W69-05314

BIOLOGICAL ASPECTS OF EUTROPHICATION IN LAKES MENDOTA, CRYSTAL, TROUT AND GREEN,
Wisconsin Univ., Madison. Lab. of Limnology,
For primary bibliographic entry see Field 02H.
W69-05324

REYNOLDS METAL CO V BALL (SUIT TO RECOVER DAMAGES FOR ALLEGED DEPOSIT OF SEDIMENT CONTAINING POISONOUS SUBSTANCES).

232 SW 2d 441-443 (Ark 1950).

Descriptors: *Arkansas, *Toxicity, *Water pollution sources, *Sediments, Judicial decisions, Legal aspects, Water pollution, Water pollution effects, Overflow, Vegetation, Sedimentation, Sediment transport, Streams.

Plaintiff brought action against defendant metal company to recover damages for injury to his land alleged to have been caused by deposits of sediment containing poisonous substances coming from defendant's plant. Court found no legal issue to be involved since the law is settled that if defendant discharged poisonous substances from its plant into a creek, and these substances, during periods of normal overflow, lodged as sediment upon plaintiff's land, destroying vegetation and depreciating the value of the land, plaintiff could recover damages. However, a factual matter as to whether the plaintiff had established that defendant was discharging poisonous substances into the creek was involved. In reversing and remanding for a new trial the court ruled that plaintiff had not satisfactorily established such fact. (Logan-Fla)
W69-05385

GARGAC V SMITH-ROWLAND CO (POLLUTION OF LAKE BY INDUSTRIAL WASTES).
170 F 2d 177-181 (7th Cir 1948).

Descriptors: *Virginia, *Industrial wastes, *Water pollution effects, *Overflow, Organic matter, Organic wastes, Fertilizers, Damages, Fishkill, Water pollution sources, Water pollution, Pollutants, Odor, Livestock, Agriculture, Water law, Ditches, Judicial decisions, Industrial plants.

Defendant corporation, while operating its fertilizer plant, emptied organic wastes into a pond on its premises. The large volume of material caused the pond to overflow into a ditch which in turn carried the wastes into a lake adjoining plaintiffs' property. Plaintiffs sued for damages, alleging the resulting pollution caused nauseating odors, injury to livestock, and fishkill. Defendant, basing his argument on an Illinois case, contended there could be no recovery for disagreeable odors created as an incident to operation of an industrial plant. The trial court found for plaintiffs. The appellate court affirmed, noting that the case on which defendant relied concerned an industrial community, not agricultural, as was involved here, and that this situation resulted in additional damages. A statement of one plaintiff, made prior to the period involved, that there was nothing improper in the plant's operations, insofaras that plaintiff was concerned, was held properly limited by the trial court to bear on the credibility of the particular plaintiff. Plaintiffs' action was held to be proper even though defendant had ceased operations in this state. (Wheeler-Fla)
W69-05387

RESERVOIR FISHERY RESOURCES,
American Fisheries Society, New York.
For primary bibliographic entry see Field 02H.
W69-05463

EFFECTS OF PHOSPHATE CONCENTRATION ON CELL DIVISION RATES AND YIELD OF A TROPICAL OCEANIC DIATOM,
Scripps Institution of Oceanography, San Diego, Calif. Inst. of Marine Resources.
William H. Thomas and Anne N. Dodson.
Biological Bull, Vol 134, No 1, pp 199-208, Feb 1968. 4 fig, 2 tab, 14 ref.

Descriptors: *Diatoms, *Phosphates, *Primary productivity, *Yield equations, Oceans, Eutrophication, Cycling nutrients, Phosphorus compounds, Phytoplankton, Water pollution effects, Pacific Ocean.
Identifiers: *Tropical oceans, *Northeastern tropical Pacific, *Cell division, Costa Rica Dome, Asterionella japonica, Chaetoceros gracilus, Phaeodactylum tricornutum.

Authors measured cell division in cultures of diatom Chaetoceros gracilis grown in media with different initial phosphate concentrations. Organism's growth rate was limited by phosphate concentrations below approximately 0.22 microgramatoms/liter and appeared to be a linear function rather than hyperbolic. In hyperbolic relationship, mu = (mu-sub-m) (S/ (K-sub-s + S)) = (1/x) (dx/dt), relating growth rate, mu, to nutrient concentrations, S, where mu-sub-m = maximum specific growth rate, x = biomass, and t = time, K-sub-s is a saturation constant numerically equal to S at which mu = mu-sub-m/2. K-sub-m for these data is about 0.12 microgram-atoms/liter. Data substantiate Thoma's earlier suggestion that phosphate does not limit phytoplankton growth in northeastern tropical Pacific, and they verify other authors' use of linear relationship in productivity equations. Authors attribute pauses in cell division at low phosphate concentrations to induced phosphatases acting on stored intracellular phosphorus or to lo extracellular concentrations. Final cell numbe were linearly related to initial phosphate concer tration up to approximately 0.8 microgran atoms/liter. Phosphorus/cell is 2 nannomicrogram atoms/cell or 10 picomicrogram-atoms/cubi micron. Diatom's increased growth upon additio of boron suggests requirement for that nutrien (Eichhorn-Wisc)
W69-05530

ACCUMULATION OF PHOSPHORUS-32 AN ZINC-65 BY LIVING AND KILLED PLANK TON,
Battelle-Northwest, Richland, Wash. Pacifi Northwest Lab.
C. E. Cushing, and D. G. Watson.
Oikos, Vol 19, pp 143-145, 1968. 1 tab, 6 ref.

Descriptors: *Phosphorus radioisotope *Radioecology, *Zinc radioisotopes, *Plankto Columbia River, Analytical techniques, Zin Phosphorus, Cycling nutrients, Radiochemic analysis, Radioisotopes, Water pollution effect Water pollution sources, Absorption, Adsorptio Phytoplankton, Periphyton, Photosynthesis.
Identifiers: *Radioactive accumulation, *Radioac tive uptake, Hanford Laboratories, Atomic reac tors, Gamma-ray spectrometry, Differential ab sorber techniques.

Authors enclosed plankton (collected at a site i the Columbia River upstream of the outfall fro atomic reactors of the Hanford Laboratories) i nets, floated them through the outfall area, an picked them up downstream at a distance about 3 kilometers from the initial point. They determine planktonic zinc-65 concentrations by counting on single-channel gamma-ray spectrometer an phosphorus-32 by differential absorber techniques Mean radiophosphorus concentrations in nannocu ries/gram of dry weight (standard error i parentheses) for eight samples each were: living 0.80 (0.120); killed, 0.49 (0.098). Similar value for radiozinc were: living, 3.51 (0.189); kollec 5.04 (0.171). Treatment differences are statisti cally significant by t-test at probability levels 0.0 for radiozinc and 0.10 for radiophosphorus Authors suggest that differences in accumulatio due to treatments result from unmasking of ca tionic binding sites for zinc and enhancement o leaching out of cellular phosphorus as a result o cell death. Above figures for accumulation can b compared to those earlier determined by author for natural populations: radiophosphorus, 9.5 (1.45); radiozinc, 8.40 (1.08). Authors suggest number of experimental and ecological factor which may account for enhanced accumulation b natural populations over that of their experimenta ones. (Eichhorn-Wisc)
W69-05531

MASONITE CORPORATION V GUY (FISH KILL: EFFECTS OF WATER POLLUTION).

77 So 2d 720-722 (Miss 1955).

Descriptors: *Mississippi, *Stream pollution *Fishkill, *Sewage effluents, Judicial decisions Path of pollutants, Pollutant identification, Pollu tion abatement, Oxygen sag, Minnows, Commer cial fishing, Fish management, Water pollution ef fects, Industrial wastes, Liquid wastes, Sewerage Biochemical oxygen demand, Damages.
Identifiers: *Comparative damages.

The plaintiff brought this suit to recover for the loss of minnows he had trapped. The fish died as a result of alleged stream pollution by the defendant The defendant owned a wood manufacturing plan and often discharged effluents into the stream These effluents reduced the oxygen content in the water to a point where it would not sustain aquatic life. The court affirmed recovery for the plaintif but reversed the issue of damages and remanded the case. It appeared from the evidence that othe parties had also discharged sewerage and filth

hich contributed to the pollution. In such cases, e defendant would be liable only for his propor- onate share of damages. (Stewart-Fla)
/69-05553

D. Waste Treatment Processes

ARGE TREATMENT PLANTS OF THE MSCHER ASSOCIATION AND THEIR IM- ORTANCE FOR IMPROVING CONDITIONS F THE RHINE,
nschergenossenschaft, Essen (West Germany).
Knop.
or the 8 Volume Proceedings, see Vol 2, No 9, eld 06B, and W69-03305. Int Conf on Water for eace, Wash, D C, Vol 4, pp 111-119, 1968. 9 p, 7 g.

escriptors: *River basin commissions, *Waste ater treatment, *Rivers, *Water pollution treat- ent, Chemical wastes, Phenols, Biodegradation, ining, Mine drainage, Mine wastes, Municipal astes.
entifiers: Germany, Rhine River, Emscher basin, nscher Association, Ruhr basin.

description is presented of conditions in the nscher basin one of the first basins in which in- strial development necessitated that all water anagement be put under one administration. epressions from coal-mining and the attendant ainage disturbances resulted in extensive vamps. The Emscher Association was created in 904 as a self-governing body to remedy existing fficulties and build a network of receiving water- urses which could be adjusted reliably to any fu- re subsidence. Representative of the scope of ork done are the double relocation of the caved- Emscher mouth and the 70 pumping stations nstructed to drain large parts of the Emscher sin. Up to World War I this waterway had such a gh natural purification capacity that mechanical eatment of all wastes within the basin was fully tisfactory. After World War I, because of an in- ease in phenol load in the Rhine, the Emscher ssociation built dephenolating plants at the collie- es. The waste-water load on the Rhine increased markedly that in 1965 the Association initiated ological treatment. The plant is a mere 1/15 of e projected large-scale biological Emscher outh treatment plant, in which all the Emscher ater up to 30 cm m/sec is to be treated biologi- lly. Work on the plant, probably the largest in urope, was started on December 1, 1966. Con- ruction costs are estimated at present to amount DM 150 millions. Once in operation the load on e Rhine from within the Emscher basin will be duced to 1/10 of its present amount. (Vorhis- SGS)
/69-05218

UTTING WASTE WATER TO BENEFICIAL SE - THE FLUSHING MEADOWS PROJECT,
gricultural Research Service, Phoenix, Ariz.
/ater Conservation Lab.
erman Bouwer.
roc 12th Annual Arizona Watershed Symposium, hoenix, Arizona, 18 September 1968, pp 25-30. 6 3 fig, 1 tab, 6 ref.

escriptors: Sewage effluent, *Waste water sposal, Waste water treatment, Water pollution, oil waste treatment, Soil percolation, *Waste ater reclamation, Induced infiltration, *Ground ater recharge, Irrigation, Denitrification, conomics.
entifiers: Surface spreading, Recharge basins, Ex- erimental recharge project, Flushing Meadows roject, Phoenix (Arizona).

central Arizona, decreasing water supplies and creasing population make reuse of municipal aste water mandatory. An experimental project est of Phoenix has shown that the hydrogeology the Salt River bed is uniquely suited for reclaim- g water from sewage effluent by surface spread- g for ground water recharge. The project con- tains six recharge basins 20 x 700 ft each. Four basins are in bermudagrass, one basin is covered with a gravel layer, and another is in bare soil. The grass basins had the highest infiltration rates, the gravel basin the lowest. Including dryup periods, an annual recharge rate of about 300 ft should be attainable. With short inundation periods (2 days) all nitrogen in the sewage effluent was converted to nitrate in the reclaimed water. With long inundation periods (10 days) 90% removal of the nitrogen was obtained, probably because of denitrification. The usual reductions in BOD, coliforms, and phosphorus were observed. Horizontal and vertical hydraulic conductivity of the aquifer were evaluated by electric analog, using water level data from two observation wells. Plans for a large-scale recharge project consisting of strips of recharge basins on each side of the river bed and wells in the center of the river bed were developed.
W69-05327

RETURNING WASTES TO THE LAND, A NEW ROLE FOR AGRICULTURE,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
Herman Bouwer.
Jour Soil and Water Conservation, Vol 23, No 5, pp 164-169, 1968. 5 p, 2 fig, 1 tab, 22 ref.

Descriptors: Sewage effluent, *Waste water disposal, Waste water treatment, Water pollution, *Soil waste treatment, Soil percolation, *Waste water reclamation, Induced infiltration, *Ground water recharge, Irrigation, Denitrification, Economics.
Identifiers: Surface spreading, Recharge basins, Experimental recharge project, Flushing Meadows Project, Phoenix (Arizona).

Land disposal of treated sewage or other liquid waste reduces pollution loads on streams and lakes. After infiltration and percolation through the soil, biodegradable material, microorganisms, phosphorus, nitrogen, heavy metals, fluorides, and other substances are effectively removed. Thus, the waste water that has percolated to the water table and then moved as ground water for some distance can be collected as reclaimed water suitable for reuse. Under favorable hydrogeologic conditions, the cost of waste water renovation by surface spreading for ground water recharge is a fraction of that of comparable tertiary in-plant treatment. Several types of land disposal of ground water recharge systems are discussed and design and operating criteria are presented. For the experimental recharge project near Phoenix, Arizona, sequences of long inundation periods (10 days) yielded much lower nitrate levels in the reclaimed water than sequences of short inundation periods (2 days). This is attributed to denitrification. In view of the increasing amounts of waste water and the urgent need for pollution control of surface waters, agriculture's role in the future will not only be to provide food and fiber, but also to serve as a medium for receiving and renovating treated sewage and other wastes.
W69-05328

WATER QUALITY CHANGES IN CONFINED HOG WASTE TREATMENT,
Kansas Univ., Lawrence.
Ross E. McKinney, and Robert Bella.
Contrib No 24, Kans Water Resources Res Inst Proj Completion Rep, 1968. 88 p, 21 fig, 12 tab, 13 ref. OWRR Project A-011-KAN.

Descriptors: *Farm wastes, *Waste treatment, *Aerobic treatment, *Hogs, Farm lagoons, Settling basins, Soil disposal fields, Sewage treatment, Disposal, Environmental engineering, Sludge disposal, Waste storage.
Identifiers: Hog farm wastes.

Treatment methods for the wastes of confined hogs are examined. Confined-animal wastes are a major pollution problem. There are about 55 million hogs in the U.S., and their wastes are largely untreated. When they occupy a large area, foraging for food, this is no problem, but under confinement the problem is similar to that of municipal waste disposal. A facility consisting of an aerobic biological treatment system for 10,000 hogs was studied. An important consideration was odor control because of a nearby metropolitan area. Recycled effluent was used for raw-waste input dilution, and paddle-wheel aerators were selected for high oxygen transfer efficiency and low operating cost. Each building had an aeration ditch under its slotted floor for aerobic processing, and final disposal was by a 2-stage infiltration pond system and field spreading of solids. Measurements were made of DO, BOD, COD, pH, suspended solids, N, and trace metals. Chemical analysis results and cost data are tabulated. Operation expense is about 1-2 cents per hog per day. Stream pollution is prevented or greatly reduced and odors are no problem. (Knapp-USGS)
W69-05417

TREATING COKE PLANT WASTE,
Bethlehem Steel Corp., Pa. Homer Research Lab.
Paul D. Kostenbader, and John W. Fleckstein.
Ind Water Eng, Vol 6, No 2, pp 30-31, Feb 1969. 2 p, 1 fig, 1 photo.

Descriptors: *Waste water treatment, *Industrial wastes, *Phenols, Ammonia, Biodegradation, Aeration, Oxidation, Oxidation lagoons.
Identifiers: Coking wastes, Steel mill wastes, Cyanide, Thiocyanates.

Phenols and other organics in coke plant wastes are biologically oxidized, and thiocyanate is oxidized to sulfate in a steel mill coking waste treatment plant in Bethlehem, Pennsylvania. Over 4,000 lb of phenol per day are treated in a weak ammonia liquor from the cooling and cleaning of coking gases. The effluent contains less than 0.1 ppm phenol. Because ammonia inhibits biodegradation, ammonia levels are kept below 2,000 ppm. At 80-95 deg F the oxidation efficiency is over 99.8%. Phosphorus is a necessary nutrient in both phenol and ammonia degradation, so phosphoric acid is added at a 1:70 phosphorus: phenol ratio. The pH is unregulated because no change in biological activity with pH can be detected. Foaming is controlled with water sprays. Thiocyanate oxidation averages 70%, and the forms of cyanide discharged are non-toxic. The plant is designed to handle 1,500,000 gpd with 5,000 ppm phenol. Equipment consists of a 1 million gal storage tank, a 130 X 40 X 12 ft aeration pond, 8 surface aerators with a total capacity of 15,000 lb oxygen per day, and a 40 ft diam by 9 ft deep clarifier. (Knapp-USGS)
W69-05422

PROCEEDINGS OF SYMPOSIUM ON BETTER WATER AND SEWER SERVICES FOR SMALL COMMUNITIES IN NORTH CAROLINA,
North Carolina Univ., Chapel Hill. Inst. of Government; and North Carolina State Univ., Raleigh. Water Resources Research Inst.
For primary bibliographic entry see Field 06B.
W69-05424

PORTABLE WATER PURIFIERS FOR COSTA RICA,
Fried-Krupp, Essen (West Germany). Zentralinstitut fuer Forschung und Entwicklung.
Rudolf Brylka.
For the 8 Volume Proceedings see Vol 2, No 9, Field 06B and W69-03305. Int Conf on Water for Peace, Wash, D C, Vol 3, pp 752-757, 1968. 6 p, 4 fig.

Descriptors: *Water purification, *Potable water, *Disasters, Volcanoes, Water pollution sources, Water supply, Filtration, Flocculation, Chlorination.
Identifiers: *Costa Rica, San Jose, Emergency water supply.

The Irazu volcano eruptions from March 1963 to December 1964 greatly impaired the water supply to San Jose and the surrounding areas, because the local waterworks, for lack of any groundwater, had to procure raw water from surface sources. Output of the existing supply system fell off because the surface water was polluted with ash, mud, and other eruption products. The German Federal Republic, under its development aid program delivered to Costa Rica portable water purifiers in capacities ranging from 0.3 to 35 cu m/hr. Two of the water purifiers were mounted on a trailer and 5 were mounted on a base plate, all having an aggregate capacity of 120 cu m/hr. Raw water was drawn from collapsible storage basins made from coated synthetic fabrics. The purifiers included filters filled with crushed lava and activated carbon and a chemicals feeder, so that treatment involved all necessary processes such as chemical flocculation, chlorination, filtration, and adsorption. A simple laboratory, pumps, and hoses were delivered with the purifiers. The purification units are used to feed clean surface water into the distribution systems in the outskirts of San Jose. (Vorhis-USGS)
W69-05456

5G. Water Quality Control

PESTICIDES: NOT ENOUGH KNOWN.

Nature, Vol 221, No 5178, pp 302-303, Jan 25, 1969. 2 p.

Descriptors: *Pesticides, *Pesticide residues, *Foods, Data collections, Legislation, Organizations, Analysis, Sampling Ecosystems, Pollutants.
Identifiers: Britain, Research needs.

As pollution of the global ecosystem by pesticides increases, it is stressed that more research is needed on most aspects of contamination. This conclusion is based upon findings of a study group in Britain which compiled information from 59 private and public organizations; it reveals widespread ignorance about this problem. Knowledge is needed, prior to legislation, on the metabolism of pesticides, the accumulation of pesticides in foods and simpler, quicker procedures for analyzing pesticide residues. A system is needed for sampling imported foods. The study group recommended that the government collect published and unpublished data, persuading industry to release new information; government chemists should be organized to collect samples for analysis; and a new committee should be formed to deal with pesticides in foodstuffs. This committee, to which the Med and Agr Res Counc and the Ass of Pub Anal should contribute members, would initiate research, collate and publicize results and make recommendations for limits of contamination. (Lang-USGS)
W69-05215

LARGE TREATMENT PLANTS OF THE EMSCHER ASSOCIATION AND THEIR IMPORTANCE FOR IMPROVING CONDITIONS OF THE RHINE,
Emschergenossenschaft, Essen (West Germany).
For primary bibliographic entry see Field 05D.
W69-05218

WATER FOR LIVING,
World Health Organization, Geneva (Switzerland).
For primary bibliographic entry see Field 05C.
W69-05219

OIL SPILLAGE STUDY, LITERATURE SEARCH, AND CRITICAL EVALUATION FOR SELECTION OF PROMISING TECHNIQUES TO CONTROL AND PREVENT DAMAGE,
Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.
G. J. Alkire, C. D. Becker, M. W. Cook, Diana Davis, and C. E. Leach.
Available from CFSTI as AD-666 289 HC $3.00, MF $0.65. Res Rep for Dep Transp, U S Coast Guard, Nov 20, 1967. Total 281 p, 2 fig, 16 tab, 761 ref, 8 chapter.

Descriptors: *Oily water, *Water pollution sources, *Water pollution treatment, Oil wastes, Ships, Navigation, Transportation, Pipelines, Path of pollutants, Biodegradation, Coagulation, Flotation, Oxidation.
Identifiers: *Oil spills, Oil tankers, Oil spill cleanup, Oil shipping technology, Oil slick removal.

Literature on the current state of technology of prevention and control of major oil spillage on water, the restoration of the shoreface and waterfowl, the effects of oil pollution, and the effect of corrective measures on aquatic life are reviewed and evaluated. Over 700 references are listed. Ship size increases, tank arrangement changes, hull proportions, bridge (ship) locations, structural design, machinery design, pumping changes, manning level reduction, and some operating practices all tend to increase the probability and severity of spills. Operating practices are being adopted, however, to reduce spillage hazards. They include oil and ballast separation, better navigation techniques, restricted traffic lanes, radar, and better weather forecasting. Regulation of offshore production to reduce spillage is both by government action and by oil companies to improve public relations but failures are still likely. Transmission line safety codes are designed to reduce hazards. Oil spills are studied by aerial surveys including spectrophotometric, ultraviolet, infrared, radar, and microwave imaging. Chemical treatment includes use of absorption and sinking agents and gelling agents. All dispersants and emulsifiers are toxic to some extent, and general opinion is against them. Oil may be confined by booms and then either burned or recovered. Technology for reclamation of recovered oil is highly developed but largely unused. (Knapp-USGS)
W69-05262

THE MICROBIAL FLORA OF ACID MINE WATER AND ITS RELATIONSHIP TO FORMATION AND REMOVAL OF ACID,
Ohio State Univ., Columbus. Water Resources Center.
Patrick Dugan, and Chester Randles.
Research Project Completion Report, Oct 1968. 124 p, 41 fig, 16 tab, 41 ref. OWRR Project A-002-Ohio.

Descriptors: Water pollution, Pollution abatement, *Acid mine water, *Acid microflora, Acid abatement, Acid metabolism, Acid tolerant bacteria, Sulfur metabolism, Sulfate metabolism, Water quality, Coal drainage, Mines, Iron metabolism.
Identifiers: Stream pollution, Mine acid, *Micoorganisms, Bacteria.

The ecology and distribution of microorganisms in acid drainage associated with coal mines indicates that biological production of acid, sulfate, and ferric ions occurs in gob piles and mines but not in receiving streams. Surges of acid are flushed into receiving waters via rainfall or other runoff. Hydrogen ion is the most toxic component to a normal heterotrophic microflora of a receiving stream sulfate has some toxic influence and ferric ion has little toxicity. Acid tolerant heterotrophs exist in highly acid streams and proliterate there. Metabolic byproducts from acid tolerant bacteria would tend to revert streams to a normal condition if acid pollution was abated. Sulfate reducing bacteria can convert sulfate to sulfide and concomittantly remove acid. This represents a potential means for treatment of acid water in specific cases.
W69-05314

NITROGEN CYCLE IN SURFACE AND SUBSURFACE WATERS,
Wisconsin Univ., Madison.
For primary bibliographic entry see Field 05B.
W69-05323

DETERMINATION OF ORGANOCHLORINE INSECTICIDES IN SOILS AND WATERS,
Wisconsin Univ., Madison. Dept. of Soils; Agricultural Research Service, Washington, D. C.
For primary bibliographic entry see Field 05A.
W69-05325

DELAWARE RIVER BASIN COMPACT.
For primary bibliographic entry see Field 04A.
W69-05342

DELAWARE RIVER BASIN COMPACT.
For primary bibliographic entry see Field 04A.
W69-05343

DELAWARE RIVER BASIN COMPACT.
For primary bibliographic entry see Field 04A.
W69-05344

DUMPING OF OIL.

Me Rev Stat Ann tit 17, sec 2794 (1965).

Descriptors: *Maine, *Water pollution, *Oil wastes, *Oil, Legislation, State governments, Pollution abatement, Chemical wastes, Water pollution sources, Industrial wastes, Rivers, Streams, Lakes, Ponds, Tidal waters, Wells, Groundwater, Surface waters, Seepage, Percolation.

The intentional placement or direct deposit of oil, petroleum base products or materials containing significant quantities of such oil into or on the banks of any river, stream, permanent or temporary lake, pond, or tidal waters or on the ice thereof where such materials may find its way into said watercourse of tidal waters is prohibited. Also prohibited is the deposit of such materials into pits, wells or on ground surfaces in such a manner that oil will percolate, seep, or otherwise find access into groundwaters or into wells used for the production of water. (Logan-Fla)
W69-05370

TENNESSEE VALLEY SAND AND GRAVEL CO V PILLING (LIABILITY FOR SEDIMENT DUMPING WHICH MAKES CREEK BED SHALLOWER, WHICH CAUSES MORE FLOODING).
47 So 2d 236-244 (Ala 1950).

Descriptors: *Gravels, *Pollution abatement, *Sediments, *Alabama, Judicial decisions, Legal aspects, Streams, Riparian rights, Riparian lands, Hydraulic structures, Mining, Silts, Water pollution sources, Pasture management, Grazing, Pastures, Muck soils, Damages.
Identifiers: Debris.

Plaintiff brought an action for damages to his land allegedly caused by negligent mining operations by the defendant. A judgment for the plaintiff was entered awarding damages for the abatable nuisance created by the defendant's mining operations. The plaintiff contended that the defendant had caused the creek abutting her property to overflow more frequently by dumping wastes into the stream and causing muck and debris buildup. These overflows cast muck upon plaintiff's pasture land, making that land unfit for grazing. Damages were awarded to plaintiff for actual injuries incurred, but the court refused to make any award for prospective damages. (Katz-Fla)
W69-05386

GREEN V MCCLOUD (ACTION TO ENJOIN SEWAGE FLOW).

303 Ky 207, 197 SW 2d 258-261 (1946).

Descriptors: *Kentucky, *Domestic wastes, *Water pollution, Prescriptive rights, Sewage sludge, Sewage effluents, Livestock wastes, Disposal, Farm wastes, Decomposing organic matter, Riparian waters, Dairy industry, Distribu-

ion systems, Nuisance (Water law), Legal aspects, udicial decisions, Poultry.

Plaintiff brought suit to enjoin defendant from interfering with a sewer line which belonged to plaintiff and another. Defendant filed a counterclaim, onsolidated with an action against two others to njoin them from allowing sewage from residences nd outbuildings to run through open ditches or buied pipes in the bed of small stream near defendant's property. From adverse judgments, defendant appealed. While there is no prescriptive right o maintain a nuisance, the fact that defendant noved onto the land upon which the nuisance exsted is an important factor to be considered in etermining the equities. The court found that the vidence authorized a finding that the sewer line mptying sewage from residences and outbuildings nto the small stream did not constitute a nuisance vhich would be enjoined and consequently afrmed the judgments. (Reed-Fla)
V69-05389

ARTIFICIAL MIXING OF DENSITY-TRATIFIED FLUIDS: A LABORATORY IN-'ESTIGATION,
Princeton Univ., N. J. Lewis F. Moody Hydrodynamics Lab., and Princeton Univ., N. J. Dept. of Civil and Geological Engineering.
For primary bibliographic entry see Field 02H.
V69-05412

WATER POLLUTION CONTROL USING BY-PASS PIPING,
California Univ., Los Angeles. Graduate School of Business; and Purdue Univ., Lafayette, Ind. Krannert Graduate School.
G. W. Graves, G. B. Hatfield, and A. Whinston.
Water Resources Research, Vol 5, No 1, pp 13-47, February 1969. 35 p, 9 fig, 14 tab, 6 ref, 1 append.

Descriptors: *Water pollution control, *Linear programming, *Water quality control, Mathematical model, Water pollution, Dissolved oxygen, Biochemical oxygen demand, Wastes, Water treatment, Taxes.
Identifiers: *By-pass piping, *Water quality management, *Delaware Estuary, Dual variables, Dual solution.

This paper presents a mathematical model of regional water quality management using by-passing piping. The model is developed within the framework of linear programming and a large-scale problem is solved using semi-realistic data from the Delaware Estuary. The solvability of the linear programming problem, as well as the general relationship between the primal and dual problems is summarized in a general theorem. A methodology for analyzing large-scale water pollution problems and for determining optimal solutions to these problems is developed and a program for controlling water quality by using by-pass piping is obtained. The method appears to have wide application in the fields of water resources and sanitary engineering. The technique of generation of elements is used in conjunction with the truncated tablean to provide efficient solutions. A possible method of taxation is indicated based on the values of the dual variables.
W69-05503

MAJOR RESEARCH PROBLEMS IN WATER QUALITY,
Research for the Future, Inc., Washington, D. C.
Earnest F. Gloyna.
For main entry see Vol 2, No 12, Field 06B, W69-05115. Water Research, pp 479-493, Johns Hopkins Press, Baltimore, 1966. 15 p, 3 tab, 19 ref.

Descriptors: *Water management, *Water quality, *Water pollution, *Water quality control, Water demand, Cities, Industries, Fish, Wildlife, Recreation, Flood control, Navigation, Drainage, Water reuse.
Identifiers: *Research problems, Stream use.

There are conflicting demands for water. Today the three leading water users--municipalities, industries, and agriculture--are being challenged by fish and wildlife, recreation, flood control, power, and navigation. While each interest exerts its influence on both quality and quantity, the effects of water use become more pronounced. To provide for a continued supply of usable water there must be an accelerated flow of ideas from the research laboratory to the field of application. This paper describes the nature of pollution, some dimensions of the quality question, the current status of water renovation, and research needs. Considerable background information is provided as research requirements are all too often based on a limited interpretation of pollution. (Loeb-Rutgers)
W69-05519

QUALITY: WATER'S FOURTH DIMENSION,
California Univ., Berkeley.
P. H. McGaukey.
Water Policy Conference, Report No 3, California University at Davis, pp 44-48, Jan 11-13, 1961. 5 p, 3 charts.

Descriptors: *Water quality, *Impaired water quality, Water pollution, Water resources, Water utilization, Urbanization.
Identifiers: Industrialization.

As America has moved into an urban-industrial-agricultural economy (as contrasted with its earlier agrarian state), the quality of the water supply has changed. It is evident that the urban population and its supporting industrial and commercial activities will be an increasingly serious contributor to a decline in water quality. The more intensive use of water made necessary by an expanding population and increasing technology inevitably leads to a lowering of water quality. The maximum benefit to all users will require management of water quality on par with, and coordinated with, management of water quantity. Our relatively fixed water resources have some maximum capacity to accept impurities and yet continue to serve all beneficial uses. (Winn-Rutgers)
W69-05524

THE COMPETITION FOR WATER QUALITY: AGRICULTURE,
California Univ., Davis.
Milton Fireman.
Water Policy Conference, Report No 3, California University at Davis, pp 49-56, Jan 11-13, 1961. 8 p.

Descriptors: *Irrigation water, *Water quality, *Impaired water quality, Water pollution, Water resources, Water utilization, Water properties, Agriculture, California.

Farmers and agriculturists are interested in the effects of irrigation waters on plant-soil-water relationships and on the chemical and physical properties of the soil, particularly as they affect crop production. The principal characteristics which determine the quality of water for irrigation are: (1) total concentration of soluble salts, (2) sodium concentration and (3) the concentration of boron, lithium or other toxic substances. Water users degrade irrigation water supplies directly or indirectly by (1) concentrating the harmful constituents already in water, (2) by adding salts to ground water, (3) by adding salts or other harmful materials to the soil where they are picked up during irrigation, or (4) by disposing harmful materials in the irrigation stream. However, because of our increasing awareness of water quality problems, the author states that these problems will be critical only on a local basis and in particular situations. (Winn-Rutgers)
W69-05525

THE COMPETITION FOR WATER QUALITY: INDUSTRY,
Ethyl Corp., Pittsburg, Calif.
James Gill.
Water Policy Conference, Report No 3, California University at Davis, pp 57-60, Jan 11-13, 1961. 4 p.

Descriptors: *Industries, *Water quality, Impaired water quality, Water utilization, Water pollution, California, Water law.
Identifiers: California Water Pollution Control Act.

In recent years there has been increased competition for water quality and quantity. The goals set for water quality must not be unrealistic. Instead they must be based on thorough analyses of contemporary conditions and needs, with flexibility built-in to meet the unknown needs of the future. It is difficult, if not impossible, to specify any single set of water quality standards for industry. As with all other users, the quality required is dependent on the use to be made of the water. Industry, recognizing its community responsibilities, supports the establishment of sound water quality requirements designed to provide for full utilization of water resources. The Water Pollution Control Act in California is an example of constructive legislation. (Winn-Rutgers)
W69-05526

THE COMPETITION FOR WATER QUALITY: DOMESTIC USE,
City of San Diego, Calif.
Paul Beerman.
Water Policy Conference, Report No 3, California University at Davis, pp 57-60, Jan 11-13, 1961. 3 p.

Descriptors: *Water quality, *Domestic water, Political aspects, Water utilization, Planning, Water allocation (Policy).

The long range objective in providing water for domestic use is to obtain, at reasonable cost, an adequate quantity and quality of water to satisfy household needs. Unlike the agriculturists, the domestic user is able to pay for the treatment of the water which he utilizes. The domestic water user of 1970 will not have a quality problem much more severe than the present one, but he will have to be convinced of the great need for research on the reuse of water, water conservation, waste treatment and other problems. Mainly, he will have to learn that these problems cannot be solved without more cooperation between political groups. The consumer of the 1980's and beyond may have to share the quality as well as the quantity of his water. (Winn-Rutgers)
W69-05527

ECONOMIC ALTERNATIVES,
California Univ., Berkeley.
Michael F. Brewer, and Stephen C. Smith.
Water Policy Conference, Report No 3, California University at Davis, pp 126-34, Jan 11-13, 1961. 7 p.

Descriptors: *California, *Governments, *Planning, State governments, Economics, Institutions, Hydroelectric power, Water resource development, Flood control, Water supply, Financing, Pricing, Contracts, Coordination.
Identifiers: Agency coordination, Water delivery contracts.

Improved flood control, better water quality control and more recreation facilities are among the benefits expected to result from California's water investment program. To proceed efficiently, the program needs reasonable, up-to-date estimates of the volume, quality and timing of the benefits which are to flow from alternative investment programs. Decisions still must be made in several areas. There are still alternatives in agency coordination, alternatives in financing, alternatives in pricing and alternatives in contract form. The various alternatives differ in their economic consequences. Adequate data, professional studies and critical thinking are necessary to choose the best possible set of alternatives. (Winn-Rutgers)
W69-05528

CLARK V GIFFORD-HILL AND CO (WATER POLLUTION BY MINING).

100 F Supp 879-881 (WD La 1951).

Descriptors: *Louisiana, *Mining, *Water pollution, *Overflow, Mud, Damages, Judicial decisions, Water pollution effects, Pollution abatement, Water pollution sources, Streams, Water management (Applied), Lakes, Mine drainage, Mine wastes, Quarries, Mineral industry, Industrial wastes, Legal aspects.
Identifiers: Injunctions (Prohibitory).

At the time of this suit, and for a considerable time prior thereto, defendant had been digging and mining gravel on its own property, which was so situated that large areas of land and small streams drained into its gravel pit. This caused a continued increase of muddy water as more space was provided by the removal of top soil and gravel. Although defendant attempted by appropriate means to stop the muddy water from flowing out of the diggings, during hard rains it overflowed, muddying a certain stream and causing damage to the plaintiff. The defendant had built levees which make it reasonably certain that there would be no more overflow. Further, defendant set up a plan to completely drain the diggings of polluted water in order to eliminate the hazard once and for all. Plaintiff, in addition to damages, requested an injunction against further pollution. The court granted the injunction, holding that the defendant should be restrained from further polluting the creek until it had returned the old digging area to normal conditions which prevailed before the gravel operations were begun. (Heckerling-Fla)
W69-05561

AMERICAN CYANAMID CO V COMMONWEALTH (POLLUTION ABATEMENT).

187 Va 831, 48 SE 2d 279-286 (1948).

Descriptors: *Virginia, *Administrative agencies, *Water pollution, *Water pollution control, Legislation, Pollution abatement, Acids, Acidic water, Acidic streams, Fish conservation, Wildlife conservation, Industrial wastes, Judicial decisions, Legal aspects.
Identifiers: Statutory interpretation, Penalties (Criminal).

Defendant was convicted under the Virginia Fish Law for casting colloids and sulfuric acid into the Piney River. Defendant contends that the State Water Control Law repealed the fish law or so far subordinated it that the defendant cannot be convicted under the fish law on the facts of this case. The control law empowered the Water Control Board to supervise and administer all laws relating to pollution of state waters. The defendant contends, therefore that the fish commission did not have authority to proceed against defendant. The court held that the control law expressly stated that its provisions merely supplemented and did not repeal prior legislation. It did require, however, that prior existing legislation be administered in accordance with the purposes of the control law. The court determined that the conviction of defendant prior to obtaining a control board permit sanctioning the pollution was lawful, but that the subsequent conviction, antecedent to securing such a permit, was not in accord with the purposes of the control law and was unlawful. (Katz-Fla)
W69-05575

STATE V GLIDDEN CO (CONSTITUTIONALITY OF WATER POLLUTIONS CONTROL STATUTE).

228 NC 664, 46 SE 2d 860-863 (1948).

Descriptors: *North Carolina, *Water pollution control, Legal aspects, Fish conservation, Fish toxins, State government, Judicial decisions, Relative rights, Legislation, Pollutants, Discharge (Water), Effluents.
Identifiers: Penalties (Criminal), Equal protection clause.

A North Carolina Statute made it unlawful to pollute the waters of the state or to discharge into such waters any deleterious or poisonous substance inimical to fish. The statute did not apply to corporations chartered before March 4, 1915. Penalties for violation included fine or imprisonment. The defendant company was charged with violation of the statute, was convicted, and was fined $5,000. Defendant appealed. The superior court sustained a demurrer to the arrest warrant, holding the statute was unconstitutional. The State appealed, and the Supreme Court of North Carolina held that the broad nature of the exception to the statute was not related to any useful purpose comprehended by the statute. Class legislation is not offensive if founded upon reasonable distinctions and uniformly applied to all members of the same class. However, in this situation, the 'cut off' date used to define classes within the statute was discrimatory and, thus, violative of the 14th amendment equal protestion clause. (Harris-Fla)
W69-05586

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

PROCEEDINGS OF SYMPOSIUM ON BETTER WATER AND SEWER SERVICES FOR SMALL COMMUNITIES IN NORTH CAROLINA,
North Carolina Univ., Chapel Hill. Inst. of Government; and North Carolina State Univ., Raleigh. Water Resources Research Inst.
For primary bibliographic entry see Field 06B.
W69-05424

A COMMENT ON OPTIMIZATION METHODS FOR BRANCHING MULTISTAGE WATER RESOURCE SYSTEMS,
Michigan Univ., Ann Arbor.
E. F. Brater.
Water Resources Research, Vol 5, No 1, pp 317-318, February 1969. 2 p, 1 tab, 2 ref.

Descriptors: *Dynamic programming, Optimization, Resources, Water distribution, Linear programming, Digital computers.
Identifiers: *Iteration, *Optimization methods, *Branching multistage systems, Nonlinear programming.

The author comments on a paper by Meier and Beightler which demonstrated the application of dynamic programming to the optimization of a five reservoir system in which two reservoirs are on a branch that enters the main stream at the middle of the three main reservoirs. The author calls attention to several numerical errors in the above paper. In equation 16 the values of d* sub 1 and d* sub 2, derived from the author's solution should be 7.10 instead of 6.10 and 2.12 instead of 3.12, respectively, and the maximum return is slightly greater than 355 rather than 354. It has been demonstrated by Loucks that nonlinear programming and linear programming optimizing techniques can also be applied to the solution of this same problem. Problems of this type can also be solved by iteration. Perhaps the most important advantage of an iteration technique is that in addition to finding the particular set of water allocations that produce the maximum return, many other sets of allocations are found that produce near maximum returns and which might be more desirable than the absolute maximum. A typical procedure for an iteration solution is described. (Loeb-Rutgers)
W69-05499

OPTIMIZATION METHODS FOR BRANCHING MULTISTAGE WATER RESOURCE SYSTEMS--A REPLY TO A COMMENT BY E. F. BRATER,
Texas A and M Univ., College Station; and Texas Univ., Austin.
W. L. Meier, Jr., and C. S. Beightler.
Water Resources Research, Vol 5, No 1, pp 319-320, February 1969. 2 p, 4 ref.

Descriptors: *Dynamic programming, Optimization, Decision making, Computers.
Identifiers: *Optimization methods, *Branching water systems, *Iteration, *Enumeration, Optimal decision, Convergence, Optimum solution.

The authors discuss two points that Brater raised on their earlier paper. First, there is a numerical error in the authors' paper. The correct values of d sub 1 and d sub 2 in Equation 16 should be 7.11 and 2.11 respectively. Furthermore, the total maximum return is slightly greater than 355. These errors were typographical errors. Brater also states that optimization as an end-product to rational decision making is not new. However, the new aspect of modern optimization technology is that the techniques developed that accelerate convergence to an optimal decision. Optimization methods such as that proposed by the authors speed convergence to an optimum by limiting unnecessary evaluations. An enumeration method similar to Brater's provides an equivalent answer to the authors' method if it converges to the absolute optimum value. Even here the analyst can't guarantee that the absolute optimum has been reached. However, dynamic programming always achieves the absolute optimum solution. The authors state that Brater's 'iteration' method used on problems like that faced by the State planning agency in Texas would lead to ruin. Since water research is often concerned, as in the authors' earlier paper, with optimization problems, this paper is applicable to present water studies. (Loeb-Rutgers)
W69-05501

EFFECT OF THE LENGTH OF THE TIME PERIOD ON SERIAL CORRELATION,
Canterbury Univ., Christchurch (New Zealand).
For primary bibliographic entry see Field 06D.
W69-05506

AN ALTERNATIVE PROOF OF HANNAN'S THEOREM ON CANONICAL CORRELATION AND MULTIPLE EQUATION SYSTEMS,
Thomas J. Watson Research Center, Yorktown Heights, N. Y.; and Ohio State Univ., Columbus.
For primary bibliographic entry see Field 06D.
W69-05511

USE OF THE DURBIN-WATSON STATISTIC IN INAPPROPRIATE SITUATIONS,
Stanford Univ., Palo Alto, Calif.
For primary bibliographic entry see Field 06D.
W69-05516

FACTOR ANALYSIS AND REGRESSION,
Illinois Univ., Urbana.
For primary bibliographic entry see Field 06B.
W69-05517

6B. Evaluation Process

COMPREHENSIVE BASIN STUDY ON WHITE RIVER BASIN, ARKANSAS AND MISSOURI.
White River Basin Coordinating Committee.

Compr Basin Study, White River, Arkansas and Missouri, Main Rep, Vol 1 of 6 vol, June 1968. 188 p, 18 fig, 2 plate, 40 tab, 5 append.

Descriptors: *Water resources development, *Multiple-purpose projects, *River basin development, *Arkansas, *Missouri, Planning, Water supply, Flood control, Recreation, Irrigation, Channel improvement, Dams, Reservoirs, Inter-Agency cooperation, Interstate rivers, Interstate commissions.
Identifiers: White River Basin (Ark-Mo), Comprehensive Basin Plan.

A comprehensive study was made of the water and land resources and needs in the White River basin, Arkansas and Missouri, plans were formulated for land and water resource uses, and programs to meet the needs were designed. The basin has an

rea of about 27,765 sq mi, of which 62% is forest nd the remainder is principally farmland. The nain economic activities are agriculture and light ndustry. Flood losses average about $97 million er yr and 3,400,000 acres suffer wetness hazard. Vater availability is sufficient for all purposes but everal headwater communities will need to in- rease their water facilities to meet expected de- nand. The 1965 municipal industrial use was about 8 mgd, and by the yr 2000, use is expected to be 57 mgd. Pollution is a problem only downstream f Springfield, Mo. and Fayetteville, Ark. The com- rehensive plan of development includes 7 main tem and major tributary multiple-purpose naviga- ion improvements, land reclamation, farm ponds, rrigation works, channel improvements, recreation levelopment, stream gage installation, and water uality control projects. Total cost is estimated to e $226,159,500 with a benefit-cost ration of 2.7:1. (Knapp-USGS)
W69-05201

A STATE VIEWPOINT ON RIVER BASIN PLANNING,
New York State Dept. of Conservation, Albany. Div. of Water Resources.
Nicholas L. Barbarossa.
ASCE Proc, J Waterways and Harbors Div, Vol 94, No WW2, Pap 5955, pp 217-238, May 1968. 22 p, 11 fig, 2 tab, 12 ref, append.

Descriptors: *River basin development, *Planning, *Water resources development, *Water Resources Planning Act, Governments, Management, Water management (Applied), Water policy, Appalachian Mountain Region, New York, Political aspects, Legal aspects, Social aspects, State governments, Interstate, Federal-State water rights conflicts.
Identifiers: Water resources council, River basin planning.

Administrative and policy implications of water resources planning and development are discussed with regard to planning concepts, federal-state-local relationships, implementation and management, and new trends. Inconsistent national water policies, overlapping new programs, and the myriad of federal agencies with divided jurisdictions dictate the need to strengthen the role of the states as partners with federal and local governments. Recent federal legislation (Appalachia and Water Resources Planning Acts, especially) will help the states in this respect. The newly created Water Resources Council can provide top-level coordination and may ultimately resolve competitive situations at the federal level. States generally have not taken advantage in the past of available opportunities, because they failed to provide the means and motivation for partnership planning and development. Current trends indicate that mutual interdependence among all levels of government will increase. New York State policies, organization, and programs are described to illustrate growing state responsibilities. Guidelines for the states in developing policies and organizations are presented.
W69-05209

INTERGRATING HUMAN-SOCIAL RESOURCES INTO THE WATER RESOURCE DEVELOPMENT PROJECT,
Inter-American Center for Integral Development of Land and Water Resources.
Stephen L. Brower.
For the 8 Volume Proceedings, see Vol 2, No 9, Field 06B and W69-03305. Int Conf on Water for Peace, Wash, D C, Vol 6, pp 454-463, 1968. 10 p, 3 fig, 6 ref.

Descriptors: *Social aspects, *Water resources development, *Social adjustment, *Human resources, Attitudes, Water management (Applied), Planning, Water utilization, Economic impact, Irrigation.
Identifiers: Human-social forces.

Major resource systems that interact and influence the success of water resource development projects are (1) the natural or physical, (2) economic, and (3) human-social and are composed of inter-related, interdependent sub-systems. Complex sets of direct and indirect relationships exist between people and the development of water resources. The human-social resource system influences and modifies the way water is utilized and conversely the introduction of a new water use, as irrigation, changes people's way of life. The decision to irrigate implies that water is a central concern either for man's economic survival, success or for the preservation of life. The resulting concerns introduce emotion-ladden decisions related to the acquisition, use, and control of water. The rational physical designs for the development of the irrigation project frequently are rendered less effective because of these intervening human-social factors. Conceptual, analytic, and methodological means are available for making water resource development technically and operationally adequate. These take into account the human-social factors which frequently contain the forces which block or reduce the effectiveness of water development projects. A paradigm defining 4 basic types of water resource planning and implementation models is presented and takes into account human-social forces which influence the success or failure of a water resource development project. (Lang-USGS)
W69-05217

THE UTILITY OF DISASTERS,
Duke Univ., Durham, N. C.
Louis De Alessi.
Kyklos, Vol 21, No 3, pp 525-33, 1968. 9 p.

Descriptors: *Disasters, Prices, Behavior.
Identifiers: *Charity, Utility analysis, Firm behavior, Individual behavior.

Empirical evidence suggests that charity increases following a disaster. The explanatory hypothesis implied by non-economists, and stated explicitly by at least some economists, is that disasters induce short-run structural changes in individual utility functions. This essay suggests that economic theory already predicts an increase in post-disaster charity. It follows that structural changes in utility functions are not a necessary condition for explaining the behavior observed, including the behavior of prices. This essay also extends the analysis to the post-disaster behavior of business firms by applying the utility maximization hypothesis to the behavior of individual decision makers within the firm. This article has relevance to theoretical treatments of flood damage and water disasters as they may effect individual utility functions and post disaster policy. (Winn-Rutgers)
W69-05288

TESTING FOR SERIAL CORRELATION AFTER LEAST SQUARES REGRESSION,
Australian National Univ., Canberra.
E. J. Hannan, and R. D. Terrell.
Econometrica, Vol 36, No 1, pp 133-50, Jan 1968. 18 p, 22 ref.

Descriptors: *Correlation analysis, Regression analysis, Fourier analysis, Efficiencies.
Identifiers: *Spectral density function, *Significance points, *Circular serial correlation, Exogenous, Residuals, Autocorrelation.

Fourier methods are used to investigate tests for the significance of the residuals from a regression. In a multiple regression on fixed regressors it is shown that if the regressors have spectra concentrated at the origin of frequencies then the upper bound of the Durbin-Watson test statistic is likely to be relevant. The structure of the spectral density matrix of regressors which makes least squares an efficient method for a disturbance with any continuous spectral density is also discussed. An alternative proof is offered for testing serial independence of the residuals from any 'just identified' or 'overidentified' equation in a multiple system of equations. Test procedures for different forms of serial dependence are discussed, and an example of this kind is investigated. Attention is focused on the case where the exogenous variables in the regression have spectra concentrated at the origin of frequencies. This article has relevance to many water simulation and empirical demand studies which by the nature of the data often exhibit significant serial correlation of the residuals. (Sokoloff-Rutgers)
W69-05289

AN INCOME-NET WORTH APPROACH TO MEASURING ECONOMIC WELFARE,
Wisconsin Univ., Madison.
Burton A. Weisbrod, and W. Lee Hansen.
Am Econ Rev, Vol LVIII, No 5, 1315-1329, Dec 1968. 15 p, 5 tab, 2 fig, 15 ref.

Descriptors: *Income, *Welfare (Economics), Taxes, Progressive taxes, Regressive taxes.
Identifiers: *Net worth, Economic position, Consumption behavior estimation, Current income.

The objective of this paper is to present an empirical measure of economic welfare, hereafter called economic position, which integrates current money income and current net worth. The proposed measure rests on the assumption that current income and current net worth are both important determinants of the economic position of a consumer unit. Merging income and net worth gives rise to difficulties, for income is a flow while net worth is a stock. The procedure proposed involves converting net worth into a flow by translating it into an annuity. The economic position for any given consumer unit at any given time is the sum of its current annaul adjusted income and the annual lifetime annuity value of its current net worth. Economic welfare as a benefit measure can be utilized in water benefits analysis particularly related to consumer water demand and the income distribution effects of water development projects. (Winn-Rutgers)
W69-05290

MONEY, MULTIPLIER ACCELERATOR INTERACTION AND THE BUSINESS CYCLE,
Carnegie-Mellon Univ., Pittsburgh, Pa. Pennsylvania Univ., Philadelphia.
Michael C. Lovell, and Edward Prescott.
Southern Econ Jour, Vol 35, No 1, pp 60-72, July 1968. 13 p, 3 fig, 19 ref, append.

Descriptors: Investment, Interest rate, Stability, Governments, Federal government, Growth rates.
Identifiers: *Money, Federal Reserve System, *Economic stability, Money supply, Business cycle, Monetary policy, Multiplier.

It has been argued that the fact that the money supply moves cyclically constitutes prime facie evidence that the best efforts of the Federal Reserve System contribute to economic instability. It has been asserted that given the limited state of current knowledge, discretionary monetary policy should be replaced by the simple rule of having the money supply increase at a constant rate. In analyzing these issues a model constituting a synthesis of the real theory of the business cycle provided by the multiplier-accelerator framework of Samuelson with the IS-LM apparatus developed by Hicks for the static analysis of the role of money in the determination of aggregate income is used. The effects of alternative stabilization policies which might be pursued by monetary authorities are analyzed for a deterministic world and for one complicated by stochastic disturbances. The analysis shows that the United States economy might be subject to greater instability if discretionary monetary policy were replaced by the Friedman-Shaw rule. Federal water projects can be conceived of as possible anti-cyclical expenditure possibilities. The role of money and monetary policy can be both augmenting and competitive to fiscal policy and this article has relevance to theoretically relating the fiscal effects of water projects to monetary actions. (Winn-Rutgers)
W69-05291

WATER RESOURCES POLICY AND POLITICAL INSTITUTIONS.
Federal Council for Science and Technology, Washington, D. C.

Panel Report, Office of Science and Technology, Washington, D. C.: U. S. Government Printing Office, July 1968. 18 p.

Descriptors: *Research and development, *Institutional constraints, *Water law, *Water resources development, Administrative agencies, Federal project policy, Measurement, Watershed management.
Identifiers: *Implementation techniques, Transbasin decision.

This panel report points out the inadequate amount of available research on water resources policy and political institutions. It contends that water policies have a far greater impact on water management than any scientific innovation. It also proposes development of appraising techniques to evaluate existing policies and institutional arrangements so that needed changes can be quickly identified; and that the Executive Office of the President take the lead in assuring that such a basic research program be developed. The report questions the existing policy of planning and developing water management by river-basin units and calls for comparative analysis studies between river-basin concepts and compact or small watershed management programs. Also questioned is the extent to which duplicate federal programs complicate or impede the resolution of conflicting water management needs. Another widely accepted concept questioned in this report is whether multi-purpose planning produces concurrent multi-purpose benefits. Suggested research to determine this is the use of the 'post-audit' technique and analyses of both multi-purpose and single purpose projects. Other research needs identified are: (1) research to determine what type of grant programs are most effective and efficient; (2) the effect of inequitable allocation of financial responsibility; and, (3) how institutional arrangements affect the role of the private sector in water resources development. (Starr-Chicago)
W69-05295

WATER LAW, POLITICS, AND ECONOMICS: OUR COMPLEX WATER LAWS AND WATER USE CUSTOMS,
Oregon State Univ., Corvallis. Water Resources Research Inst.
For primary bibliographic entry see Field 06E.
W69-05296

WATER LAW, POLITICS, AND ECONOMICS: FEDERAL CONTROL OF WATER RESOURCES,
Oregon State Univ., Corvallis. Water Resources Research Inst.
For primary bibliographic entry see Field 06E.
W69-05297

HARBOR DEVELOPMENT PORT OF PORTLAND, MAINE.
Greater Portland Chamber of Commerce, Maine; Union Design Groups, Newport, R. I.

Greater Portland Chamber of Commerce, February 1969. 123 p, 10 maps, 19 illus.

Descriptors: *Harbors, *Land use, *Public benefits, Shoreline protection, Water quality, Aesthetics, Legal aspects, Financial feasibility.
Identifiers: *Portland (Maine), Residential development.

The report advocates planning wherein proposals and recommendations by special interest groups are presented in an effort to influence and guide public policy. The pressure of higher priorities for development and urban renewal in Portland and South Portland has deferred public action or waterfront developments. The planning and development goals underlying this study are: (1) maximum public and private benefit from the use of waters for navigation, recreation and commerce; (2) maximum public and private benefits from the use of waterfront land areas for industrial, commercial, recreational and residential purposes; (3) maximum aesthetic and amenity value; (4) reconciliation of conflicting land uses; (5) relating waterfront development to regional and local planning; and, (6) classification and coordination of port development responsibilities. Some of the specific objectives outlined are: (1) elimination of blight and decay; providing facilities and services to support expansion of industry, commerce, recreation and housing; (3) developing viable programs for environmental improvement; and, (4) developing legislative and fiscal programs to support these activities. (Starr-Chicago)
W69-05298

THE PLAN AND PROGRAM FOR THE BRANDYWINE.
Chester County Water Resources Authority, West Chester, Pa.; and Pennsylvania Univ., Philadelphia. Inst. for Environmental Studies.

Institute for Environmental Studies, University of Pennsylvania, October 1968. 277 p, 32 map, 87 tab, 6 illus, 22 graphs, 1 append.

Descriptors: *Land use, *Flood plain zoning, *Easements, *Water quality, Community development, Growth rates, Social aspects, Psychological aspects.
Identifiers: *Chester County (Pennsylvania), Water districts, Flood plain management.

Proposals for the wise use of the water and land resources of the Upper East Branch of Brandywine Creek, in Chester County, Pennsylvania are presented. Preservation of the water supply and water quality, accommodation of normal growth and preservation of the natural amenities are the principal planning goals. Three recommendations are made, and a program based on the acceptance by the public of these recommendations, is outlined: (1) Further development dept out of the flood plains and 300 foot wide strips on each side of stream with limited development in wooded areas and on steep slopes; (2) Townships should undertake long range planning for the design, financing and construction of sewerage and water supply systems to accommodate future growth; and, (3) Townships should enact strong regulations governing layout of subdivisions, roads and storm sewers. Given public acceptance of these recommendations, the Chester County Water Resources Authority will proceed with the following program: (1) Establish a Water Resource Protection District; (2) Purchase conservation easements from owners of land in the District who agree voluntarily to sell such easements in a single sub-basin where owners of at least 80% of the lands agree; (3) Authority would require initial financial support from both the County Commissioners and outside agencies; and, (4) Extend the easements -purchase program to other sub-basins so that eventually all of the land in the District would be placed under development restrictions. The recommendations made are the result of the hydrologic, legal, attitudinal, economic, demographic and other technical studies contained within this report. (Starr-Chicago)
W69-05299

PROCEEDINGS-SYMPOSIUM ON BETTER WATER AND SEWER SERVICES FOR SMALL COMMUNITIES IN NORTH CAROLINA.
North Carolina Univ., Chapel Hill. Water Resources Research Inst.
For primary bibliographic entry see Field 03D.
W69-05312

EAST FORK DUCK CREEK WATERSHED; NOBLE AND WASHINGTON COUNTIES, OHIO.
Soil Conservation Service, Washington, D. C.

Preliminary Investigation Report, pp 1-12, Jan 1968. 12 p, 5 tab.

Descriptors: *Cost-benefit ratio, Flood plains, *Flood damage, Roads, Flood control, *Flood protection, Watershed, *Watershed managment, Conservation, Resource development, Ohio, *Washouts.
Identifiers: *East Fork Duck Creek Watershed.

In view of the unfavorable benefit-cost ratio for flood prevention found in this study, no feasible watershed work plan can be developed at this time. The level of protection provided by this system did not meet Soil Conservation Service standards throughout the flood plain. Courses of action which may justify continued pursuit for the watershed were discussed with local people. These possible courses include: (A) Attempt to get affected roads abandoned, or relocated, with other funds, so that road costs will not be a project cost. (B) Postpone further action until present PL-566 procedures are liberalized. (C) Use most feasible portions of the best project alternate for consideration under Buckeye Hills Resource Conservation and Development Project.
W69-05329

PROCEEDINGS OF SYMPOSIUM ON BETTER WATER AND SEWER SERVICES FOR SMALL COMMUNITIES IN NORTH CAROLINA,
North Carolina Univ., Chapel Hill. Inst. of Government; and North Carolina State Univ., Raleigh. Water Resources Research Inst.
David H. Howells.
Water Resources Res Inst Rep No 15, Univ N C, Chapel ill, Dec 4, 1968. 113 p, total 6 fig, 5 ref. OWRR Project A-999-NC.

Descriptors: *Planning, *Water resources development, *Sewage, *Rural areas, Waste water treatment, Governments, Institutions, Area redevelopment, Administration, Legislation, Programs, North Carolina, Community development.
Identifiers: Rural sewage planning, Rural water resources.

A seminar was held to examine current water and sewer programs for small North Carolina towns in the context of Federal and State programs, State law, and planning for financing, construction, and management of water and sewer systems. The strengths and weaknesses of present governmental arrangements for planning are discussed in detail and recommendations are made for their study and modification. The problems considered are largely those of urbanization. Both central cities and declining rural areas face declining tax bases and demand for more services, for which one successful solution discussed is regionalization of governments. (Knapp-USGS)
W69-05424

BROAD SCOPE OF NAVIGATION'S ECONOMIC IMPACT,
Tennessee Valley Authority, Knoxville. Div. of Navigation Development.
Minard I. Foster.
ASCE Proc, J Waterways and Harbors Div, Vol 95, No WWI, Pap 6389, pp 23-34, Feb 1969. 12 p, 2 fig, 5 tab.

Descriptors: *Navigation, *Economic impact, Employment, Industrial production, Industries, Social impact, Tennessee Valley Authority Project, Political aspects.
Identifiers: Decatur (Ala).

A new development associated with the economic impact of navigation is the rise of waterfront industrial complexes where industries once were few or non-existent. The numerical estimate of jobs required to furnish inputs to waterfront plants and the number of jobs required to utilize non-final output of these plants provides a clue to the economic or locational impact of this dynamic segment of industry. Publicly available information concerning the input-output relationships between types of in-

dustry and the tendency of some kinds of plants to spawn new ones furnishes an insight into their economic linkages. A comprehension of the far-reaching influence navigation has upon economic growth in rural as well as urban areas may be of significant benefit in the process of making decisions on public investments to provide navigation in situations were other aspects are conducive to such growth. (Knapp-USGS)
W69-05449

REGIONAL RESEARCH IN WATER IN THE NORTH CENTRAL REGION,
South Dakota State Univ., Brookings; and Wisconsin Univ., Madison.
Gordon D. Rose, and Dean T. Massey.
Opportunities for Regional Research on Water Resources Problems, pp 1-19, Iowa City, University of Iowa, 1968. 20 p, 44 ref.

Descriptors: *Central U S, *Administration, *Regional analysis, Networks, Regions, Manpower, Economics, Legal aspects, Water resources, Planning, Coordination.
Identifiers: *North Central Region Research Project NC-57, Hatch Act.

The purpose of this paper is to re-examine legal and economic regional water resources research in the North Central Region of the U S. Part one outlines the organizational structure for regional research enacted by Congress and the interpretation the Cooperative State Research Service has given that legislation in their Manual of Procedures for Cooperative Regional Research. The second part reviews the history and accomplishments of North Central Region Research Project NC-57, a project organized in the region to study the legal and economic aspects of water resources. The authors conclude that a modification in the present method of conducting regional research is necessary; current activities could be conducted equally well without a regional project. In fact, most of these activities would have been conducted if the NC-57 project had not existed. (Winn-Rutgers)
W69-05478

DISCUSSION OF REGIONAL RESEARCH IN THE NORTH CENTRAL REGION,
Dept. of the Interior, Washington, D. C.
Roland R. Renne.
Opportunities for Regional Research on Water Resources Problems, pp 20-22, Iowa City, University of Iowa, 1968. 3 p.

Descriptors: *Water Resources Research Act, *Central U S, *Coordination, *Regional analysis, Administration, Manpower, Regions, Water resources.

The amended Water Resources Research Act of 1964 provides for regional research in Water resources. However, true regional research is not easy to achieve. After three full years of operation, the Office of Water Resources Research in the Department of the Interior has very little truly regional water research in operation. The Office of Water Resources Research is sponsoring many water research projects in the North Central Region. These projects contain little, if any, duplications with NC-57 projects. The relationship between the two programs is supplemental, not duplicative. (Winn-Rutgers)
W69-05479

CONCEPTUAL ISSUES IN THE CONDUCT OF REGIONAL RESEARCH ON THE ECONOMICS OF WATER,
Oregon State Univ., Corvallis.
Emery N. Castle.
Opportunities for Regional Research on Water Resources Problems, pp 23-32, Iowa City, University of Iowa, 1968. 10 p.

Descriptors: *Regional analysis, *Water resource development, *Methodology, Social aspects, Water transfer, Political aspects, Economics, Economic efficiency, Institutions.
Identifiers: *Interdisciplinary research, *Multidisciplinary research, Regional research, Externalities, Economic growth.

The author's main ideas can be summarized as follows: (1) Water research is mission oriented research stemming from specific social problems; (2) The solution of most social problems requires the contribution of more than one discipline; (3) Successful regional research in economics is comparatively rare; (4) The involvement of more than one discipline adds to the complexity of regional research; (5) Perhaps the most fruitful use of other disciplines is in problem formulation; (6) Since water is not an expensive production or consumption item, the naive application of an efficiency framework may not result in the most useful research; (7) Water gives rise to externalities. Institutional devices have developed in response to these externalities.
W69-05480

DISCUSSION OF CONCEPTUAL ISSUES IN THE CONDUCT OF REGIONAL RESEARCH ON THE ECONOMICS OF WATER,
Kansas State Univ., Manhatten.
E. S. Bagley.
Opportunities for Regional Research on Water Resources Problems, pp 33-36, Iowa City, University of Iowa, 1968. 4 p.

Descriptors: *Regional analysis, Methodology, Water resource development, Resource development.
Identifiers: Interdisciplinary research.

Regional research does not require any unique or special methodology. The unique research problems encountered in regional research are not methodological or theoretical, but largely procedural, stemming from the political subdivisions involved in the organization, financing and conduct of research. There has been overinvestment in water development. The emphasis on engineering feasibility may have been in part responsible for inadequate attention to economic factors. Legal and political factors may have contributed to a too narrow regional scope in conceiving of the problem. However, one must ask why these influences are less likely to forestall overinvestment in water than in land or other resources. (Winn-Rutgers)
W69-05481

REGIONAL AND NATIONAL PLANNING OF AGRICULTURAL RESEARCH,
North Central Agricultural Experiment Station, Iowa City, Iowa.
George M. Browning.
Opportunities for Regional Research on Water Resources Problems, pp 37-43, Iowa City, University of Iowa, 1968. 7 p.

Descriptors: *Methodology, Agriculture, Research and development, Planning, Regional analysis.

The author discusses several recommendations made by the joint USDA and State agricultural experiment station (SAES) Task Force designated to conduct the long range study of agricultural research. These recommendations are guidelines for research. No single research approach or organizational arrangement can provide the information necessary to answer all the questions concerning agriculture. The most important single ingredient for a successful research and development program is the individual scientist with a new idea. Resources are not available to permit research on all the proposed projects. This emphasizes the importance of identifying the most important problems and placing priorities on them. This article can be applied to water research. The clear dependence of agriculture upon water supply and the inherent concern of agriculture with water problems make this article relevant to issues in water research. (Winn-Rutgers)
W69-05482

WATER ALLOCATION: SUPPLY AND DEMAND RELATIONSHIPS,
Iowa State Univ., Ames.
John F. Timmons.
Opportunities for Regional Research on Water Resources Problems, pp 44-56, Iowa City, University of Iowa, 1968. 13 p, 1 tab.

Descriptors: *Water allocation (Policy), *Pricing, Water Demand, Water resource development, Water supply, Water shortage, Water quality, Water users, Water right.
Identifiers: *Opportunity costs, Institutional rationing, Value productivity.

The author begins this article by reconsidering some relevant concepts such as the mythology of uniqueness and shortages imputed to water, the sanctity of the present allocative devices, and the homogeneity illusions of water. The author then notes that approximations of water supply and demand should not be considered as aggregates but as segmented differentiated supply and demand approximations derived from relevant estimators. When the demand for water exceeds its supply, research is concerned with allocating a scarce resource among completing ends. There is opportunity for research concerned with the development of water use firms identified by water use entities at appropriate levels of aggregation and decision making. (Winn-Rutgers)
W69-05483

DISCUSSION OF WATER ALLOCATION: SUPPLY AND DEMAND RELATIONSHIPS,
South Dakota State Univ., Brookings.
Arthur J. Matson.
Opportunities for Regional Research on Water Resources Problem, pp 57-60, Iowa City, University of Iowa, 1968. 4 p.

Descriptors: *Water allocation (Policy), Water demand, Water supply, Water resources development, Water rights.
Identifiers: Opportunity costs.

In his comment on Dr. Timmon's paper, the author discusses the following points: (1) Closing options may be part of the costs offsetting the benefits assumed from the allocation of water supplies and the investment in water resource development; (2) Preserving flexibility in use and assuring certainty in claiming rewards from investments are conflicting features of development policy; (3) Improvement in the state of knowledge could place choices in allocation under ordinal, if not cardinal, criteria; (4) A challenge for the economist is to generate educational material on issues that will be useful at a level of aggregation that promotes agreement among local people and hence promotes economic allocation of resources. (Winn-Rutgers)
W69-05485

WATER RESOURCE DEVELOPMENT: PUBLIC AND PRIVATE INVESTMENT,
Michigan State Univ., East Lansing.
A. Allan Schmid.
Opportunities for Regional Research on Water Resources and Problems, Iowa City, University of Iowa, 1968, pp 61-78. 18 p, 36 ref.

Descriptors: *Return (Monetary), *Investment, *Resource development, *Resource allocation, Economic efficiency, Economics, Resources, Regional analysis, Interest rate, Profits, Flood control.
Identifiers: *Nonmarginal economics, Surplus crops.

This article is concerned with the problem of how to put water development investments in a context which will help decision makers to make judgments on the major directions in resource use. Comparisons of returns between projects in entirely different branches of economic activity are likely to be less meaningful than comparisons between projects in the same branch. However, solutions to the problems of resource allocation seem to require substantial reallocation of resources among the dif-

ferent branches of economic activity. The problem is further complicated in that the real issue is not which activity has the highest return when considered alone, but what is the proper mix of investments and how does one affect the returns of the other. Here the problem becomes one of coordination and timing of various kinds of human and nonhuman resource development projects. (Winn-Rutgers)
W69-05486

DISCUSSION OF WATER RESOURCE DEVELOPMENT: PUBLIC AND PRIVATE INVESTMENT,
Wisconsin Univ., Madison.
William B. Lord.
Opportunities for Regional Research on Water Resources and Problems, Iowa City, University of Iowa, 1968, pp 79-83. 5 p, 2 ref.

Descriptors: *Resource development, *Investment, Economics, Regional analysis, Planning.
Identifiers: Nonmarginal economics.

The systems analysis approach to problem solving is becoming more common. Many of the traditional approaches of economic analysis, such as the theory of the firm, eliminate by assumption systems effects. Techniques need to be developed for the evaluation of nonmarginal changes. Better empirical tools are also needed for nonmarginal analysis. Economists can contribute to three areas which concern regional research: (1) the delineation of the optimal planning unit, (2) the study of regional institutions, and (3) the evaluation of regional investment alternatives. Water development projects are an aspect of the overall regional development program and hence this article can refer to the problems and issues involved in regional water activities. (Winn-Rutgers)
W69-05487

REGIONAL ECONOMIC DEVELOPMENT AND WATER,
Iowa State Univ., Ames.
Wilbur R. Maki.
Opportunities for Regional Research in Water Resources Problems, Iowa City; University of Iowa, 1968, pp 84-104. 21 p, 2 fig, 5 tab, 17 ref.

Descriptors: *Regional analysis, *Resource development, Distribution patterns, Cities, Industries, Population, Community development, Investment, Water utilization.
Identifiers: *Regional growth stages, Regional economic development, Central areas, Peripheral areas.

A geographic redistribution of population and industry is occurring at a rapid rate. With increased population and economic concentration in central areas, improved access to peripheral areas is a growing concern of both the center and periphery population. Conflicts may develop over water use because water is mainly valued for its income generating effects in the peripheral areas while it is primarily valued as an element supporting area residential activities and amenities in the central area. Metropolitan centers, because of their dominant status in a geographic grouping of subareas, are centers for organizing multi-purpose information systems. Public information on private investment opportunities and social investment requirements is a critical input in the resource development process.
W69-05488

DISCUSSION OF REGIONAL ECONOMIC DEVELOPMENT AND WATER,
Pennsylvania State Univ., University Park.
J. Dean Jansma.
Opportunities for Regional Research in Water Resources Problems, Iowa City, University of Iowa, 1968, pp 105-107. 3 p, 5 ref.

Descriptors: *Regional analysis, Water resources development, Economic efficiency.
Identifiers: Regional growth.

Some research is available on the increase in efficiencies attained through spatial concentration. However, there are private and social costs of amortizing prior investment in the peripheral areas. While it may be advantageous in a national efficiency framework to have programs which require that investments be made in viable growth centers, perhaps we have not considered the cost of absolescence in the nonviable areas. There is no single goal of regional growth. The goal is dependent on whether one is concerned with (1) increasing aggregate regional income, (2) increasing per capita income, or (3) decreasing interregional differences in factor prices. The behavioral patterns are not only different for the three groups but they may be contradictory. The role of water resources in the development pattern has relevance to all of considerations of regional growth mentioned above. (Winn-Rutgers)
W69-05489

DATA SYSTEMS AND INFORMATION RETRIEVAL ADAPTABLE TO WATER RESOURCES,
Department of Agriculture, Washington, D. C.
Paul L. Holm.
Opportunities for Regional Research on Water Resources Problems, pp 108-129, Iowa City, University of Iowa, 1968. 22 p, 2 fig, append.

Descriptors: *Information retrieval, *Data storage and retrieval, Data collections, Data processing, Documentation.
Identifiers: *Data systems, Data base systems, Reference systems, Text processing systems, Data banks, Analytical data systems, Data systems.

Without adequate data the most sophisticated planning and research techniques are useless. Much attention has been given to developing the tools of information retrieval and data systems. The information retrieval systems which have been developed can be classified into three groups: data base, reference and text processing systems. The data contained in a data system provides the basis for developing information. In some systems the data is analyzed by the system, while in others it is not. This difference provides a basis for classifying data into two categories: data banks and analytical data systems. A detailed statement of the content of data systems required in regional water research can be made only after research scientists decide what types of data are required. (Winn-Rutgers)
W69-05490

A DISCUSSION OF DATA SYSTEMS AND INFORMATION RETRIEVAL ADAPTABLE TO WATER RESOURCES,
Pennsylvania State Univ., University Park.
John C. Frey.
Opportunities for Regional Research on Water Resources Problems, pp 130-133, Iowa City, University of Iowa, 1968. 4 p.

Descriptors: *Information retrieval, *Data storage and retrieval, Data collection, Data processing, Documentation.
Identifiers: Data systems.

Data banks and information retrieval programs are developments which help man increase his capacity to recall. If there are limits to the resources that can be used to build data systems and information retrieval programs, care must be taken in selecting inputs of data and information. Advisory panels representing users and potential users from many different walks of life can be used to guide the input selection process. A clue to input priorities may also be obtained from user requests. A problem in the operation of data banks is that some of the data may have limitations or logical use restrictions which are not revealed by the print outs. The full benefit of a central facility may best be realized by establishing satellite collection and distribution stations. This article is relevant to water research data banks and retrieval systems. (Winn-Rutgers)
W69-05491

LONG SWINGS,
Queen's Univ., Kingston (Ontario).
Jon P. Harkness.
Rev Econ and Stat, Vol LI, No 1, pp 94-96, February 1969. 3 p, 1 tab.

Descriptors: *Regression analysis, Fourier analysis, Leakage, Frequency.
Identifiers: *Spectral analysis, *Long swings, *Harmonic regression, *Long cycles, *Trend removed deviation from trend, Trend, Exponential trend, Polynomial trend, Lags.

In a recent article, this writer presented the results of a spectral analysis of a wide variety of historical time series in order to test the existence of long swings in the Canadian economic experience. While several similar studies had been carried out on the United States data, it was argued that such studies had generally been poorly conceived both with respect to spectral analysis and to the particular version of the long-swing hypothesis being tested. A new test for long cycles in deviations from the trend of an economic variable was to be more compatible with spectral analysis. It is the intent of this note to briefly present the findings of a similar test carried out on the United States data. The harmonic regression is discussed as a method of trend elimination. Harmonic regression expresses the given time series as a trignometric polynomial function of time. Spectral analysis has been used and can be used in many types of water research problems such as demand studies and water flow analysis. (Loeb-Rutgers)
W69-05498

WELFARE ECONOMICS, ECONOMIC GROWTH AND THE CHOICE OF TECHNIQUES,
Warwick Univ., Coventry (England).
S. K. Nath.
The Journal of Development Studies, Vol 4, No 2, pp 220-240, Jan 1968. 21 p, 15 ref.

Descriptors: *Economics, *Social value, Social aspects, Economic efficiency, Welfare (Economics), Value, Resource allocation, Investment, Cost-benefit analysis.
Identifiers: *Value judgments, *Criteria, Technological efficiency, Economic growth, Sectoral allocation, Rate of turnover criteria, Rate of surplus criteria.

No practical economic problem can be meaningfully discussed without explicitly starting with some social objectives and some idea of their relative weights. Arguments and criteria which are paraded as technical, economic or non-controversial tests of suitability or efficiency inevitably beg a number of value judgments which need to be made explicit. At times accounts of cost-benefit analysis seem to suggest that such an analysis must necessarily proceed on the basis of the market value of things; but in logic there is no such necessity. What elements are to be considered as costs and what are to be considered as benefits and how they are to be evaluated are questions which can only be answered by a specific social welfare function or statement of a given country in a given situation. This article has relevance to water resource studies that utilize the familiar cost-benefit methodology. By calling attention to the role of value judgments in these analyses, the article provides a broader perspective to water resource development programs.
W69-05500

THE TENNESSEE VALLEY AUTHORITY: ECONOMIC IMPACT OF ITS COMPREHENSIVE WATER DEVELOPMENT PROGRAM,
George H. R. Taylor.
For 8 volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 8, May 1968, pp 664-679. Washington, D C: U S Government Printing Office. 16 p.

Descriptors: *Water resources development, Labor, Flood control, Navigation, Electric power,

Reforestation, Benefits, Employment, Income, Fertilizers, Erosion control, Forestry, Mineralogy, Recreation, River basins.
Identifiers: *Tennessee Valley Authority, *River control, Economic program, Industrialization, Job creation, Farm income, Economic growth, Economic regions.

This paper analyzes the TVA resources based economic program in both its direct and indirect aspects, and in its intra-regional and extra-regional aspects. The problems dealt with are industrialization; employment patterns and wage levels; strengthening of organized labor; personal income; job creation; expansion of economic and other activities by state and local entities; farms practices and farm income and use and cost of electric power. These problems are treated as they have been affected by TVA programs in electric power; navigation; fertilizer and demonstration farms; erosion control; forestry; minerals; recreation; tributary development; economic research and cooperative planning with non-federal entities. The relevancy of the TVA experience in developing a river basin's resources base to aid in stimulating economic growth, diversity and broadened options of the people of the region is discussed as applicable to, (1) other U. S. river basins or economic regions and (2) developing nations.
W69-05502

PROCEEDINGS OF THE THIRD ANNUAL AMERICAN WATER RESOURCES CONFERENCE.
American Water Resources Association, Urbana, Ill.

Proceedings of the Third Annual American Water Resources Conference, Nov 8-10, 1967, Urbana, Illinois. 669 p.

Descriptors: Water, Water quality, Water resources, Water resources development, Water law, Water analysis, Water demand, Water management (Applied), Water policy, Water pollution, Economics, Water utilization, Regional analysis, Planning.

This book contains all the papers presented during the ten sessions of the Third Annual American Water Resources Conference. The articles deal with many aspects concerning water resources including water quality management and protection, legal and institutional considerations, water resources planning, and water supply augmentation. Although the articles are primarily concerned with water problems within the United States, a few articles consider U. S. participation in international efforts designed to make better use of water. (Winn-Rutgers)
W69-05508

THE INTERINDUSTRY FACTOR-CONTEXT MATRIX: AN APPLICATION FOR THE ANALYSIS AND PROJECTION OF REGIONAL WATER REQUIREMENTS,
California Univ., Berkeley.
Everard M. Lofting, and H. Craig Davis.
Proceedings of the Third Annual American Water Resources Conference (American Water Resources Assn: Urbana, Ill), 1967, pp 294-303. 10 p, 1 fig.

Descriptors: *Water requirements, *Cost-benefit analysis, *Input-output analysis, Forecasting, Regional analysis, Mathematical models, Leontief models, Planning.
Identifiers: Interindustry analysis, Interindustry factor-content matrix, Water content matrix.

Benefit-cost analysis is often used to evaluate the suitability of a given project. This analysis is invariably a form of partial equilibrium analysis with certain gross assumptions made about the growth of effective demand and with the assumption that other factors remain unchanged. For the greatest efficiency in investment planning, it appears necessary to begin with the structure of the economy and its expected growth and then work back to the project on an iterative basis rather than begin with the project and let the economy structure itself around the project. Quantitatively, the effect of a unit change in final demand can be traced through the typical interindustry table and the effects on interindustry purchases and gross output can be analyzed for any sector. Analysis in this article applies to a region that is relatively self-contained. Ultimately the multiregional approach to water planning problems must be faced. (Winn-Rutgers)
W69-05509

DISTRIBUTED LAGS: A SURVEY,
Chicago Univ., Ill.
Zvi Griliches.
Econometrica, Vol 35, No 1, pp 16-49, January 1967. 34 p, 6 fig, 68 ref.

Descriptors: Regression analysis, Markov processes, Monte Carlo method.
Identifiers: *Distributed lags, Lag generation function, Lag operators, Pascal distribution, Serial correlation, Identification, Adaptive expectations model.

Several recent generalizations of the geometrically declining distributed lag model are reviewed and the associated statistical estimation problems are discussed. Attention is drawn to the practical difficulties of distinguishing between different lag schemes and models on the basis of usual economic data. This leads to a discussion of the more general problem of estimating mixed autoregressive schemes with serially correlated disturbances and a review of the existing theoretical rationale for the various suggested distributed lag models. In view of the extensive use of distributed lags in econometrics, this article might provide the researcher in water problems with sufficient insight so as to allow the use of distributed lags in many empirical problems in water research.
W69-05514

RATIONAL DISTRIBUTED LAG FUNCTIONS,
California Univ., Berkeley.
Dale W. Jorgenson.
Econometrica, Vol 32, No 1, pp 135-149, January 1966. 15 p, 15 ref.

Descriptors: *Approximation method, Regression analysis, Probability, Estimating.
Identifiers: *Distributed lag functions, Parameters, Generating function, Pascal distributed lag, Koyck method.

The purpose of this paper is to introduce a class of distributed lag functions having the properties that an arbitrary distributed lag function may be approximated to any desired degree of accuracy by a member of this class and that the number of parameters required for a satisfactory approximation is less than that required for an equally good approximation by a finite distributed lag function. Such a technique might prove useful when investigating water problems via econometric methods where water flow simulations and regressions may be expressed in distributed lag form.
W69-05515

FACTOR ANALYSIS AND REGRESSION,
Illinois Univ., Urbana.
John T. Scott, Jr.
Econometrica, Vol 34, No 3, pp 552-562, July 1966. 11 p, 2 tab, 27 ref.

Descriptors: *Regression analysis.
Identifiers: *Factor analysis, *Multicollinearity, Indexes, Intercorrelation, Principal component analysis, Errors in variables, Statistical tests.

The underlying hypothesis in factor analysis is that a set of related variables can be adequately described by a set of factors less in number than the set of variables. The procedures of factor analysis obtain the values for the factors and the values for coefficients of regression where the variables are regressed upon the factors. These coefficients of regression are referred to in the psychological and factor-analysis literature as factor loadings or factor coefficients. Factor analysis has been used very little by economists. Some economists have used the first principal component of factor analysis in the construction of indexes. Factor analysis appears to be a particularly appropriate tool in the economic field where many 'independent' variables have high intercorrelation and where there are errors in all variables. Stochastic linear equations can be obtained from factor analysis which give better coefficients than do least squares regression equations. As such, the above method can replace or improve traditional least squares approaches to water research problems. The paper presents the factor model and its assumptions, provides references for stochastic methods of factors analysis and suggests test statistics. (Loeb-Rutgers)
W69-05517

AUTOCORRELATION BETWEEN FIRST DIFFERENCES OF MID-RANGES,
Birmingham Univ. (England).
H. E. Daniels.
Econometrica, Vol 34, No 1, pp 215-219, January 1966. 5 p, 6 ref.

Descriptors: Average.
Identifiers: *Autocorrelation, *First differences, *Mid-ranges, Spurious correlation.

It is known that if in a time series constructed from independent increments the individual items are replaced by, say, monthly averages, spurious correlation is introduced between successive first differences of the averages. The corresponding correlation for other statistics such as the mid-range is studied here. It is shown that the effect is even more pronounced when mid-ranges are used in place of averages. The danger of misleading conclusions is therefore greater, not less, when mid-ranges are used in place of averages. This problem exists for any empirical water analysis employing first differences and/or averages of increments as variables.
W69-05520

THE ESTIMATION OF MARGINAL PRODUCT FROM A COBB-DOUGLAS PRODUCTION FUNCTION,
New South Wales Univ., Kensington (Australia).
P. R. Fisk.
Econometrica, Vol 34, No 1, pp 162-172, January 1966. 11 p, 5 tab, 8 ref.

Descriptors: *Marginal productivity, Sampling.
Identifiers: *Marginal product, *Cobb-Douglas Production Function, Sampling properties, Normally distributed errors, Bias, Precision, Variance matrix.

The sampling properties of the usual estimator of marginal product from a Cobb-Douglas production function are studied under the assumption of normally distributed errors. The asymptotic normality of these estimators is demonstrated and certain special cases are considered for which the asymptotic distribution is particularly simple. An alternative estimator of marginal product is suggested which has both a smaller bias and greater precision than the usual estimator. Estimators of the variance-covariance matrix of all marginal product estimators mentioned are given. These are accurate to order n raised to the -1. Production functions are necessarily implicit in any investigation of water supply and water costs and represent in economic theory an important aspect of the link between theoretical economics and water research. The results of this paper have relevance to the properties of water production and cost studies.
W69-05521

ECONOMIC ALTERNATIVES,
California Univ., Berkeley.

For primary bibliographic entry see Field 05G.
W69-05528

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

ECONOMICS AND FINANCING OF IRRIGATION PROJECTS,
Ministry of Irrigation and Power (India).
K. P. Mathrani.
For the 8 Volume Proceedings, see Vol 2, No 9, Field 06B and W69-03305. Int Conf on Water for Peace, Wash, D C, Vol 7, pp 412-419, 1968. 8 p, 1 tab.

Descriptors: *Economics, *Irrigation, *Expenditures, *Costs, Cost-benefit ratio, Cost repayment, History, Long-term planning, Future planning (Projected), Government finance, Irrigable land.
Identifiers: *India, *Irrigation capital, *Irrigation potential.

Since 1950 when India embarked on a planned economy, irrigation works are begun by State Governments only with the approval both of the Government of India and the Planning Commission. During the three 5-year plans, expenditures on irrigation projects have amounted to 12,500 million rupees ($1,670 million) as compared to 1,560 million rupees ($210 million) in the whole pre-plan period. The ultimate irrigation potential of the country is about 200 million acres, and the more than half is expected to be developed by the end of the fourth Plan (1971). To develop the remaining potential, and investment of about 60,000 million rupees will be necessary. These projects are likely to be more difficult and proportionately more expensive than ones executed in the past. The paper reviews briefly the history of irrigation development in India, methods used in calculating cost-benefit ratios, and in obtaining irrigation revenues. (Vorhis-USGS)
W69-05221

A STUDY OF THE EFFECT OF TAXATION ON THE SIX PRIVATE OR QUASI-MUNICIPAL WATER UTILITIES IN RHODE ISLAND,
Rhode Island Univ., Kingston. Water Resources Center.
Marvin Pitterman.
Completion Report Washington, D. C. June, 1966, 21 pp. OWRR Project A-005-RI.

Descriptors: *Water utilities, *Taxes, Consumer.
Identifiers: *Rhode Island, Franchise tax, Revenue.

The important conclusions reached in this study were: (1) Taxes do not detract from the private or quasi- municipal water utilities development. (2) Utilities taxation does not lessen the quality of service to the consuming public. (3) The private or quasi-municipal water utility bears the impact of utility taxation. (4) The incidence of utility taxation is borne by the consuming public. (5) Rate increases must be slightly higher due to utility taxation. (6) The Utility Commission protects the consumer from unwarranted rate increases. (7) The utility taxation does not prevent water utilities from servicing expanding areas.
W69-05316

DISCUSSION OF WATER RESOURCE DEVELOPMENT: PUBLIC AND PRIVATE INVESTMENT,
Wisconsin Univ., Madison.
For primary bibliographic entry see Field 06B.
W69-05487

PROCEEDINGS: WATER POLICY PRICING CONFERENCE,
California Univ., Los Angeles.
Arthur F. Pillsbury.
Proceedings: Water Policy Pricing Conference, California University at Los Angeles, March 19, 1968. 109 p.

Descriptors: *Pricing, *Water rates, Public utilities, Utilities, Water policy, Economics, Legal aspects, Welfare (Economics), Financing, Cost allocation.
Identifiers: Accounting.

This book contains the seven papers and panel discussion presented at the Water Pricing Policy Conference sponsored by the Advisory Council of the Water Resources Center at the University of California. The main conclusion of this conference is that planners, economists, lawyers, auditors, financial consultants, and consumers should all be involved in the development of equitable pricing policies. Improvements are needed in the methods of policy development. Several suggestions to this problem were offered by the participants of the conference. (Winn-Rutgers)
W69-05492

LEGAL CONSTRAINTS IN WATER PRICING POLICY,
Martin McDonough.
Proceedings: Water Pricing Policy Conference, California University at Los Angeles, pp 42-50, March 19, 1968. 9 p.

Descriptors: *Legal aspects, *Pricing, *Water rates, Judicial decisions, Public utilities, Water distribution (Applied), Discriminatory pricing.
Identifiers: *Rate level, *Rate structure.

Discussion of water pricing is frequently divided between rate level and rate structure consideration. The local public body exercising the management function of rate making will in most cases be strongly influenced by the public utility tradition of raising at least enough money from rates to cover all the costs pertaining to the water system. The law generally does not determine for the policy maker what proportion of the necessary funds he must raise by rates, as distinguished from other sources of revenue. With respect to rate structure, the extent to which different rates may be charged to different classes of customers, the legal situation is more complex. Where the difference in rates is to achieve social objectives, to meet competition or to reflect some other noncost related consideration, most legal questions arise as to whether or not the discrimination is due. (Winn-Rutgers)
W69-05493

THE ACCOUNTANT'S VIEWPOINT ON WATER PRICING POLICY,
Peat, Marwick, Mitchell and Co., San Diego, Calif.
Herbert L. Beckett.
Proceedings: Water Pricing Policy Conference, California University at Los Angeles, pp 51-57, March 19, 1968. 7 p.

Descriptors: *Water rates, *Pricing, Public utilities, Utilities, Cost allocation, Costs, Water policy.
Identifiers: Accounting.

The accountant is involved with water pricing policies when rendering a service to management in connection with the initial financing of water projects, the long range financial planning and the annual budgeting of anticipated revenues and expenditures. The first element of water pricing policy is the determination of the total costs of the public water agency. Then there must be a determination of the total costs which should be recovered from the water users. Costs must be allocated to many different classes of water users. The costs of providing water to each class of users is the basic guide to water pricing. However, the benefits received by each user, his ability to pay and the overall public interest must also be considered. The final decisions on water pricing policy are generally made by public officials. (Winn-Rutgers)
W69-05494

THE CONSUMER'S VIEWPOINT AND POLICY DECISIONS,
California Univ., Los Angeles.
Hans H. Doe.
Proceedings: Water Pricing Policy Conference, California University at Los Angeles, pp 74-82, March 19, 1968. 9 p.

Descriptors: *Pricing, *Water rates, California, Costs, Benefits, Cost allocation.

Water pricing decisions determine who shall pay the water agency costs. Water boards should recognize and follow the principle that the beneficiary should be required to repay the agency for the cost of his benefits. The specific rules required to implement the principle will vary with the type of agency and existing conditions, but recognition of the principle makes easier the formulation of rules that will result in a rate structure that is at least as fair as circumstances permit. The basic rules to implement the principle are: (1) identify each benefit conferred by the agency, (2) determine the cost of each benefit, (3) identify the beneficiaries, and (4) apportion each group its share of the cost of the benefit. (Winn-Rutgers)
W69-05495

STATEMENT,
University of Southern California, Los Angeles.
J. Morley English.
Proceedings: Water Pricing Policy Conference, California University at Los Angeles, pp 86-91, March 19, 1968. 6 p, 1 fig, 6 ref.

Descriptors: *Pricing, *Water rates, Marginal cost, Legal aspects, Investments, Marginal benefit, Economics, Taxes.
Identifiers: *Marginal cost pricing, Accounting, Pareto optimal price.

It should be a relatively simple matter to establish appropriate laws once the fundamental principles for pricing water are determined. The economist's model for a marginal cost basis for pricing is irrefutable. The difficulty is to impute a valid price based on a correct evaluation of all the benefits. Furthermore, the determination of costs is not easy. The economist's model implicitly assume that the marginal cost function is continuous. In reality, introduction of new facilities introduces discontinuities. To develop a marginal cost curve without discontinuities, some basis must be provided for the allocation of capital costs over time. A Pareto price is an optimal price, given a state of wealth for each consumer. For a different wealth distribution a different optimum price will result. Thus, there is no one price for water which is optimal in an economic system in which wealth distribution can change. (Winn-Rutgers)
W69-05497

CAPITAL FORMATION AND GOVERNMENT CAPITAL POLICY IN DEVELOPING ECONOMIES,
Tel Aviv Univ. (Israel).
Haim Ben-Shahar.
The Journal of Development Studies, Vol 4, No 1, pp 86-96, Oct 1967. 11 p, 1 fig.

Descriptors: *Capital, *Loans, Financing, Investment, Governments, Risks, Foreign countries, Resource allocation.
Identifiers: *Underdeveloped countries, *Capital formation, Neutral loan policy, Selective loan policy, Discriminatory loan policy.

In many developing countries governments intervene in the capital market in order to encourage savings and investments. It is often claimed that by this intervention the governments distort resource allocation. The purpose of this paper is to suggest a rationale for such intervention. The main justification for government activity is to utilize potential economies of scale and net benefits of a developed finance system. This can be achieved where the government acts as a neutral financial intermediary. Additional social gain can be achieved where the government intervenes in the process of capital allocation through an active loan policy. As long as the social and private considerations concerning

the optimum rate of economic growth and real income allocation between successive generations are incompatible, the intervention may increase total welfare. This article is relevant to policy makers who must decide to what extent water resource development should be left to private enterprise.
W69-05518

A NOTE ON THE DUAL PRICES OF INTEGER PROGRAMS,
Princeton Univ., N. J.
Roger E. Alcaly, and Alvin Y. Klevorick.
Econometrica, Vol 34, No 1, pp 206-214, January 1966. 9 p, 1 fig.

Descriptors: *Linear programming, Prices, Constraints, Costs, Profit.
Identifiers: *Dual prices, *Integer programs, Baumol-Gomory method, *Free goods, Nonzero prices, Optimal solution, Output, Subsidy.

In an earlier article Baumol and Gomory consider the problems created by the dual prices of an integer programming problem. They present a method for recomputing these dual prices so as to remedy some of these defects. This paper proposes an alternative view of the Baumol-Gomory recomputation process, which enables a reconciliation of the integer and linear programming properties. Moreover, the authors propose a further alteration of the Baumal-Gomory method that can be applied to cases in which nonzero prices are imputed the free goods in order to remove this property. The authors also show that even this method may not be entirely satisfactory in coping with the free goods problem. This method may be helpful when investigating the public good nature of water and in attempting to assign implicit values and prices for water in certain of its uses.
W69-05523

6D. Water Demand

THE FUNDAMENTAL ROLE OF WATER IN THE 'CASSA PER IL MEZZOGIORNO' DEVELOPMENT PROGRAMS FOR SOUTHERN ITALY,
Cassa per il Mezzogiorno (Italy).
R. Dentice d'Accadia.
For the 8 Vol Proc, see Vol 2, No 9, Field 06B and W69-03305. Int Conf on Water for Peace, Wash, D C; Vol 6, pp 181-191, 1968. 11 p, 2 fig, 2 tab.

Descriptors: *Water management (Applied), *Multiple-purpose projects, *Water resources development, Developed waters, Project purposes, Optimum development plans, River basin development, Water supply, Evapotranspiration.
Identifiers: Italy, Cassa per il Mezzogiorno.

The Italian government in 1950 established the 'Cassa per il Mezzogiorno' an agency for the development of the South and the Islands of Italy (about 43% of Italy) with its main objective the solution of water supply problems. Only 15% of the rainfall occurs in the summer, loss by evapotranspiration is high, short independent river courses, do not have large basins, and impermeable and steep land areas cause rapid runoff to the sea. Surface-water development by 1966 included 26 storage dams constructed or underway with 1,500 million cu m storage capacity' 27 others with 2,000 million cu m were in the planning or study stage. The groundwater program included study of 1,650,000 ha, electrical and seismic study of more than 700,000 ha, census of 15,000 wells, drilling of 531 test wells with total footage of 45,872 m, and pumping tests on 335 wells. Between 1953 and 1961, 115,000 measurements were made on 9,000 springs, with 1,177 springs measured periodically. The Cassa per il Mezzogiorno has in the past 15 yr brought 620,000 ha under irrigation, furnished water for more than 15 million people, provided water supply needs for 40 industrial areas, and plans to supply about 400 cu m per person per year by 1980. (Vorhis-USGS)
W69-05216

WATER ALLOCATION: SUPPLY AND DEMAND RELATIONSHIPS,
Iowa State Univ., Ames.
For primary bibliographic entry see Field 06B.
W69-05483

DISCUSSION OF WATER ALLOCATION: SUPPLY AND DEMAND RELATIONSHIPS,
South Dakota State Univ., Brookings.
For primary bibliographic entry see Field 06B.
W69-05485

INCREASING OR DECREASING RETURNS TO SCALE IN THE CONSTANT ELASTICITY OF SUBSTITUTION PRODUCTION FUNCTION,
Technical Univ. of Budapest (Hungary).
Gyorgy Szakolczai, and Janos Stahl.
Rev Econ and Stat, Vol 21, No 1, pp 84-90, February 1969. 7 p, 5 tab, 17 ref.

Descriptors: Homogeneity, Capital, Labor, Return to scale.
Identifiers: *Increasing returns to scale, *Decreasing returns to scale, *CES production function, Cobb-Douglas production function, Marginal rate of substitution.

An attempt has been made to develop an increasing or decreasing returns to scale CES production function, and to measure the degree of homogeneity, the marginal rate of substitution and the elasticity of substitution and capital and labor embodied as well as disembodied technical progress. The best results have been obtained with a labor series uncorrected for quality changes. With these labor data, the rate of returns to scale is 1.5, the rate of capital-embodied, and disembodied technical change 5 and 1.4 per cent yearly, respectively, and for the elasticity and the 1930 value of the marginal rate of substitution 0.8 and 12, respectively. A closer scrutiny of the findings revealed, however, that the results obtained for the rate of returns to scale depend on the method employed to correct for cyclical changes. It seems impossible to obtain a reliable measure for this parameter without having an independent estimate for changes in the actual utilization of the capital stock. Production functions of this nature might be helpful in evaluating the production of water and similar estimation and theoretical problems apply to analyses of water production functions. (Loeb-Rutgers)
W69-05505

EFFECT OF THE LENGTH OF THE TIME PERIOD ON SERIAL CORRELATION,
Canterbury Univ., Christchurch (New Zealand).
A. C. Rayner.
Rev Econ and Stat, Vol LI, No 1, pp 107-108, February 1969. 2 p, 1 tab.

Descriptors:
Identifiers: *Time period, *Serial correlation, Error term, Misspecification, Random factors, Biased estimates, Lagged error term, Autocorrelation.

There has been an increase recently in the use of econometric models based on periods of less than one year. Part of this is the result of the belief that the short period model more correctly describes economic behavior. With the use of short period models, there is often a tendency for the estimated serial correlation of the error terms to be positive. However, while the use of short period data may give rise to serial correlation of the errors this can be overcome by conventional serial correlation correction methods on the model being estimated. Suppose that due to a lack of the necessary observations, a model which is thought to apply in the short period has to be estimated using long period data. This procedure is likely to mask any short period serial correlation there might be so that the form of the model cannot be corrected as suggested above. To the extent that the estimated model does not include the lagged error term, it is an incorrect representation of short period economic behavior. This article has relevance to time series studies of water demand and also to simulation models of water flow generated from a time series stochastic process. (Loeb-Rutgers)
W69-05506

THE ECONOMICS OF WATER ALLOCATION IN UTAH,
Utah Univ., Salt Lake City.
Iver E. Bradley, and J. P. Gardner.
The Economics of Water Allocation in Utah, Salt Lake City, Utah University, December 1968. 81 p, 13 tab, 1 chart, 16 ref, append. OWRR 14-01-0001-827.

Descriptors: *Input-output analysis, *Utah, *Water allocation, *Income, Welfare economics, Marginal income, Economics, Mathematical models, Resource allocation, Water demand, Water policy, Employment, Social impact, Agriculture, Industries, Governments, State government.
Identifiers: Multiplier, Marginal value, Marginal analysis.

This study on the economics of water allocation in Utah using input-output analysis has generated two sets of estimates: (1) estimates of the (joint) marginal value (in terms of income and employment) of water, and (2) estimates of the increase in the demand for water intake for the state as a whole and for its individual sectors. The methodology behind these estimates was to treat the state as an integrated, homogeneous economic entity whose function is to maximize welfare (measured preferably in terms of household income) by the appropriate allocation of resources. The state's job is to sense the profile of future demand that is preferred by the market system, and then to allocate the water resources in a way that ensures that the gap between actual final demand and the anticipated final demand is as small as possible. According to this study, the marginal income value of water to the state is lowest for the agricultural sectors. The relative values of water in different industry sectors are considered. (Winn-Rutgers)
W69-05507

THE INTERINDUSTRY FACTOR-CONTEXT MATRIX: AN APPLICATION FOR THE ANALYSIS AND PROJECTION OF REGIONAL WATER REQUIREMENTS,
California Univ., Berkeley.
For primary bibliographic entry see Field 06B.
W69-05509

AN ALTERNATIVE PROOF OF HANNAN'S THEOREM ON CANONICAL CORRELATION AND MULTIPLE EQUATION SYSTEMS,
Thomas J. Watson Research Center, Yorktown Heights, N. Y.; and Ohio State Univ., Columbus.
Gregory C. Chow, and D. K. Ray-Chaudhuri.
Econometrica, Vol 35, No 1, pp 139-142, January 1967. 4 p, 6 ref.

Descriptors: Regression analysis.
Identifiers: *Hannan's Theorem, *Canonical correlation, *Multiple equation systems, Simultaneous equations, Maximum likelihood, Generalized variance ratio.

This proof of a theorem of E J Hannan on the estimation of parameters in simultaneous stochastic equations emphasizes the equivalence between maximum likelihood and generalized variance ratio. It includes a proof of a theorem on maximizing the ratio of two determinants det ANA/det AMA with respect to A, and develops the restrictive assumption of Hannan's theorem in relating a simultaneous equations system and canonical correlation theory. This article would be relevant for attempts to develop a stochastic simultaneous model for water demand and use.
W69-05511

USE OF THE DURBIN-WATSON STATISTIC IN INAPPROPRIATE SITUATIONS,
Stanford Univ., Palo Alto, Calif.

Marc Nerlove, and Kenneth F. Wallis.
Econometrica, Vol 34, No 1, pp 235-238, January 1966. 4 p, 1 tab, 5 ref.

Descriptors:
Identifiers: *Durbin-Watson statistic, *Serial correlation, Lagged endogenous variables, Autoregressive scheme, Asymptotic bias, Autocorrelation.

In recent years the Durbin-Watson statistic has been used uncritically to test for serial correlation in the residuals of relationships containing lagged endogenous variables which are estimated by single or simultaneous equations methods. When lagged endogenous variables are included in an equation estimated by ordinary least squares, however, the Durbin-Watson statistic is asymptotically biased towards 2 (the value which it should have if no serial correlation is in fact present). It is doubtful, therefore, that the statistic should be used either to test for serial correlation in the residuals or to provide any indication of the extent of such correlation when the estimated equation contains lagged values of any endogenous variable. This property should be known when econometric methods are applied to water problems where the estimating equation contains lagged endogenous variables. This may occur in empirical analyses of water demand.
W69-05516

THE TYPICAL SPECTRAL SHAPE OF AN ECONOMIC VARIABLE,
Nottingham Univ. (England); and Stanford Univ., Palo Alto, Calif.
C. W. J. Granger.
Econometrica, Vol 34, No 1, pp 150-161, January 1966. 12 p, 5 fig, 11 ref.

Descriptors: Stability, Control, Frequency.
Identifiers: *Spectral shape, *Spectral analysis, *Economic variable, *Power spectra, Business cycles, Model building, Trend, Covariance stationary.

In recent years, a fairly large number of power spectra have been estimated using economic data. The almost unanimous result of these investigations is that the vast majority of economic variables, after removed of any trend in mean and seasonal components, have similarly shaped power spectra. It is the purpose of this paper to illustrate this result and to discuss briefly its implications both for economic theory in general and for economic model building in particular. Spectral methods are based upon the idea of the decomposition of a stochastic process into a number of orthogonal components, each of which is associated with a 'frequency.' Such a decomposition is always possible for processes that are 'covariance stationary.' The power spectrum records the contribution of the components belonging to a given frequency band to the total variance of the process. If a band contributes a large portion of the total variance it may be considered to be important compared to a band which contributes a smaller amount to the variance. The spectral method can potentially be quite useful to the researcher when applying econometric techniques to water problems, and in particular to empirical studies of water demand. (Loeb-Rutgers)
W69-05522

6E. Water Law and Institutions

A STATE VIEWPOINT ON RIVER BASIN PLANNING,
New York State Dept. of Conservation, Albany. Div. of Water Resources.
For primary bibliographic entry see Field 06B.
W69-05209

THE ORGANIZATION OF VENEZUELA FOR THE UTILIZATION OF ITS WATER RESOURCES (SPANISH),
Ministry of Public Works (Venezuela). Dept. of Hydraulic Works.
Francisco G. Aguerrevere.
For the 8 Volume Proceedings, see Vol 2, No 9, Field 06B and W69-03305. Int Conf on Water for Peace, Wash, D C, Vol 1, pp 369-382, 1968. 14 p.

Descriptors: *Water resources development, *Optimum development plans, *Governments, Water requirements, Water resources, Legislation, Planning, Irrigation, Water utilization.
Identifiers: Venezuela.

Venezuela's institutional structure for utilization of the country's water resources is characterized by the multiplicity of organizations having a part in it. At the national level, there are several Ministries and independent agencies, each with its varied internal organization, which in many cases makes it difficult to coordinate activities toward a possible common action in a given region. There has been a great deal of concern over finding a solution to the problem of institutional organization. It appears from the study of these conditions that there is no single solution for all cases and that each country must seek its own. In the case of Venezuela, some partial progress has been achieved, above all in the use of water resources for farming purposes, this being the field where the utilization of such resources is most complex and where, therefore, the highest relative gains have been made since 1960, when the Venezuelan Agrarian Reform Law was enacted. However, from the national standpoint the organization continues to be the same as before, with separate offices for each use. In order to be able to improve the institutional organization, it is necessary to revise and modernize the laws under which it operates. In Venezuela this problem has been deferred far too long. Legislation in this field is scattered and in many cases contradictory, which calls for a coherent body of laws befitting the needs of the country and the realities of the 20th century. (Knapp-USGS)
W69-05220

A LAWYER LOOKS AT WATER RESOURCE ECONOMICS,
Missouri Univ., Columbia.
Donald R. Levi.
American Journal of Agr. Econ., Vol 51, No 1, pp 182-183, Feb 1969. 2 p.

Descriptors: *Institutional constraints, *Water law.

The legal constraints on allocation and use of water resources make letter-perfect case studies which may result in the creation of policy. Thus, the water resource economist is in a position to help shape future policies in regard to water resources. Two roles exist for the economist interested in systems of water law: (1) to identify legal constraints; and (2) to eliminate such constraints. Several reasons exist why water resource economists have not successfully fulfilled such roles. They are the tendency to criticize without accompanied constructive alternatives; selecting a forum for research that is not read by legislators; the tendency to ignore political feasibility; and the failure to bridge the communications gap. (Grossman-Rutgers)
W69-05292

ROLE OF STATE GOVERNMENTS IN U. S. WATER MANAGEMENT,
Dwight F. Metzler.
For eight volume Proceedings see Vol 2, No 9, W69-03305. International Conference on Water for Peace, 1967, Washington: U. S. Gov't. Printing Office, Vol 5, pp 402-406, 1968. 5 p.

Descriptors: *Administration, *State governments.

The basic responsibility for managing water is carried by the state. These responsibilities of the state are for making water available to support the maximum economic development, for preventing water pollution, for protecting rights to water, and for allocating water among competing uses. A survey of the participation by various states in water management show that some states have programs in (1) basic data collection, (2) public education, (3) implementing legislation, (4) planning, and (5) policy development. The progressive states attempt to carry out their responsibilities through close cooperation between the legislative and executive departments of state government. (Grossman-Rutgers)
W69-05293

WATER RESOURCES POLICY AND POLITICAL INSTITUTIONS.
Federal Council for Science and Technology, Washington, D. C.
For primary bibliographic entry see Field 06B.
W69-05295

WATER LAW, POLITICS, AND ECONOMICS: OUR COMPLEX WATER LAWS AND WATER USE CUSTOMS,
Oregon State Univ., Corvallis. Water Resources Research Inst.
Chapin D. Clark.
Oregon State University, Seminar proceedings, July 1965, pp 5-20. 16 p.

Descriptors: *Riparian rights, *Appropriation, *History, Judicial decisions, Legislation, Arid lands, Water supply, Water users, Water utilization, Droughts, Administration, Oregon.

The report summarizes the water law which regulates private rights to the use of surface water. It describes the riparian doctrine, which is a body of principles of common law developed in the water-abundant eastern United States. Two basic theories of the doctrine are identified. The doctrine is illustrated with a hypothetical court case. Final observations about the riparian doctrine include its indefiniteness, its recognition of only two conflicting parties rather than needs of all water users, protection of investments, waste of particular water supplies, and arbitrary discrimination against certain uses. Many eastern states adhere to the riparian doctrine, but severe droughts cause many to enact other legislation. The water-short West needed to establish certainty of water rights. Much of its history concerns modification or rejection of established riparian principles. The 'California doctrine' is extensively described. 'California doctrine' states recognize both riparian and appropriate rights in varying degrees. 'Colorado doctrine' states rejected riparian rights and recognize only appropriation rights. Elements of an appropriative right, and characteristics and administrative aspects of the appropriation doctrine are described. Progressive modification of the riparian doctrine in Oregon is discussed extensively, including Oregon's Supreme Court decisions and 'Water Code' of 1909. (Gossen-Chicago)
W69-05296

WATER LAW, POLITICS, AND ECONOMICS: FEDERAL CONTROL OF WATER RESOURCES,
Oregon State Univ., Corvallis. Water Resources Research Inst.
Chapin D. Clark.
Oregon State University, Seminar proceedings, July 1965, pp 21-41. 21 p.

Descriptors: *Federal jurisdiction, *Judicial decisions, *Water resources, Legal aspects, Navigable waters, Non-navigable waters, Proprietary power, State jurisdiction, Federal-state water rights conflicts.
Identifiers: *Federal constitution, Federal-private claimant water rights conflicts.

The report discusses the constitutional sources of the federal government's authority to develop, utilize, and conserve water resources and certain landmark decisions of the U. S. Supreme Court. Power over the nation's water resources is founded upon the general powers expressly delegated to Congress, e.g., under the Commerce Clause and the Property Clause of the Constitution. The report relates the history of Congress' commerce power. Constitutional dictates and Supreme Court cases

e used to extensively discuss federal control of avigable and non-navigable waters, the expanding ncept of navigability, the effect of exercising mmerce power upon non-federal interests, and e proprietary power of Congress. Constitutional urces of authority for water legislation other than e Commerce and Property clauses include the ar Power, Treaty-making Power, and the General elfare Clause. The discussion reveals a 19th cen- ry legacy of navigation servitude of private in- rests to the nation and state laws governing ivate water rights. It illustrates 20th century deral-state conflicts and federal-private claimant nflicts, as the federal government becomes in- easingly active in resource matters. he report ints to the fact that our legal structure is in- dequate for today's problems. (Gossen-Chicago)
/69-05297

ROCEEDINGS-SYMPOSIUM ON BETTER /ATER AND SEWER SERVICES FOR SMALL OMMUNITIES IN NORTH CAROLINA.
orth Carolina Univ., Chapel Hill. Water esources Research Inst.
or primary bibliographic entry see Field 03D.
/69-05312

HE ORIGIN AND DEVELOPMENT OF THE /ATERWAYS POLICY OF THE UNITED TATES,
lational Waterways Conference, Inc., Washing- n, D. C.
or primary bibliographic entry see Field 04A.
/69-05338

EGAL ASPECTS OF THE SMALL /ATERSHED PROGRAM IN IOWA,
owa Univ., Iowa City. Agricultural Law Center.
or primary bibliographic entry see Field 04D.
/69-05339

FFSHORE PROSPECTING AND MINING AWS OF THE UNITED STATES,
eslie J. Goodier.
Mining Engineering, Vol 20, No 7, pp 152-153, uly 1968. 2 p, 1 tab, 1 chart.

Descriptors: *Continental shelf, *Mining, Minerals, *Boundaries, International law, Oceans, Jnited States, Federal government, Tariffs, Geophysics, Core sampling, Oil, Submerged land ct, State governments, Leases, Financing, Legal spects.
Identifiers: Subaqueous land, Territorial sea.

The International Law of the Continental Shelf ex- ends the boundary of coastal nations to the edge of he continental shelf. The outer boundary now ex- ends to any depth that can be mined by advanced ining technology. Minerals mined beyond the ontinental shelf of the United States are con- idered 'imported' and subject to tariffs if brought ack into the country. The federal government ontrols all underwater land from the outer boun- lary of the territorial sea to the edge of the con- inental shelf. Permits will be difficult to obtain if oring equipment or explosives are used. After a rospecting survey has been completed, a request or an offshore land lease must be submitted. The idding is competitive, and the original prospector ound be outbid. Separate leases are issued for gas, il, and minerals, so the same land could be leased o several organizations. The government is now lividing the sea floor into 5,760 acre lots. These re to be leased, with rent payable in advance. The Submerged Land Act of 1933 grants to the coastal tates the right to manage the lands and natural esources of the sea floor up to three statute miles rom the coast. (Shevin-Fla)
W69-05340

MASSMAN-DRAKE V TOWBOAT M/V HUGH C BLASKE, BARGE CHEM 2 (ACTION FOR DAMAGES CAUSED BY A TOWBOAT CAST ADRIFT BY A HURRICANE).

289 F Supp 700-707 (E D La 1968).

Descriptors: *United States, *Hurricanes, *Vessels, *Cofferdams, Judicial decisions, Damages, Rivers, Ships, Navigation, Transportation, Legal aspects.
Identifiers: Acts of God, Proximate cause.

Plaintiffs allege that their cofferdam, a fixed object, was struck and damaged by the tug Blaske and one of the barges in tow as they floated down the river and that the collision was caused entirely by the fault of the tug Blaske and her crew. The defense was on the grounds of laches, unavoidable accident, act of God, and lack of negligence. The lines securing the tug and her tow to the shore had been separated when struck by other barges. These barges had themselves been separated from the shore by a hurricane. The court concluded that the evidence required the conclusion that the damage to the cofferdam was the result of an act of God over which the captain of the vessel had no control since it appeared that the captain, in securing his vessel, took all precautions commensurate with the information at hand or available. Verdict was for the defendant. (Childs-Fla)
W69-05341

DELAWARE RIVER BASIN COMPACT.
For primary bibliographic entry see Field 04A.
W69-05342

DELAWARE RIVER BASIN COMPACT.
For primary bibliographic entry see Field 04A.
W69-05343

DELAWARE RIVER BASIN COMPACT.
For primary bibliographic entry see Field 04A.
W69-05344

DELAWARE RIVER BASIN COMPACT.
For primary bibliographic entry see Field 04D.
W69-05345

RIPARIAN LANDS.

N J Stat Ann secs 12:3-1, 12:3-71 (1968).

Descriptors: *Riparian lands, *Beds under water, *Ownership of beds, *New Jersey, Riparian rights, Legislation, State governments, Tidal waters, Land tenure, Land usage, Landfills, Piers, Bulkhead lines, Docks, Hudson River, Real property, Local governments, Investigations, Surveys, Rights-of-way.
Identifiers: *Commerce and Navigation Board, Dept of Conserv and Economic Development, New York Bay, Kill von Kull, Raritan Bay, Newark Bay, Palisades.

The New Jersey Legislature has given the Commerce and Navigation Board authority over all submerged lands within certain exterior bulkhead and pier lines bounding the tidewaters adjacent to the New Jersey coastline. The Board now has the power to make surveys, leases and grants of submerged lands controlled by the state. Navigable waters beyond the exterior lines are protected. Grants of submerged lands may be made by the Board to political subdivisions within the state. Confirmatory leases and grants may be made to riparian owners claiming title under prior authority. The state may re-enter land held by a delinquent lessee as provided in the act. Mooring of boats to riparian lands is restricted and violations may be acted upon by the Board. The state may acquire riparian lands and submerged lands under the tidewater. The state, through the Commerce and Navigation Board, may lease these lands for purposes of commercial enterprises. (Kelly-Fla)
W69-05346

ESTABLISHMENT OF STATE CONTROL OVER SUBMERGED LANDS.

N J Stat Ann secs 12:3-1 to 12:3-4 (1968).

Descriptors: *Riparian rights, *Navigable waters, *Beds under water, *New Jersey, Hudson River, Legislation, Delaware River, Water law, Coasts, Land tenure, Ownership of beds, Tidal waters, Riparian land, State governments, Landfills, Pier, Bulkhead lines.
Identifiers: New York Bay, Kill von Kull, Raritan Bay, Newark Bay, Department of Conserv and Econ Development.

Sections 12:3-1 to 12:3-4 provide for examination of the limits of the state's control over land under tidal waters, and for fixing certain limitations on private use. Section 12:3-1 provides for appointment of a board of commissioners to survey the land under New York Bay, the Hudson River, Kill von Kull, Newark Bay, Arthur Kill, Raritan Bay and parts of the Delaware River; to ascertain the rights of the state thereto; and to fix exterior limits for permanent obstructions. Section 12:3-2 authorizes the establishment of exterior bulkhead and pier lines in Hudson River tidewaters, New York Bay, and Kill von Kull as reported by the commission, subject to section 12:3-13 or a subsequent act. Section 12:3-3 prohibits filling or building beyond established bulkhead lines. Piers must be built according to size limits, allowing free water passage. Section 12:3-4 repeals the Wharf Act of 1851, restoring, however, no alleged right to fill land. Only the Department of Conservation and Economic Development may allow reclaimation of, and building on, land under tidewaters, unless the right was granted before 1891. Later grants are revocable. (Kelly-Fla)
W69-05347

CONVEYANCES OF LANDS BY LEGISLATIVE AUTHORITY.

N J Stat Ann secs 12:3-5 to 12:3-7.1 (1968).

Descriptors: *Land tenure, *Ownership of beds, *Tidal waters, *New Jersey, High water mark, Landfills, Boundaries, Land reclamation, Legislation, Riparian rights, Beds under water, Water law.
Identifiers: Department of Conserv and Econ Development.

Sections 12:3-5 to 12:3-7.1 pertain generally to conveyances or leases of land under tidal waters. Section 12:3-5 allows a grantee or licenses by authority of a prior act to secure written proof of the conveyance, whether the land is presently under water or not. Reasonable rental or purchase price may be required by the state. Any lessee so desiring may afterward convert his lease into a conveyance upon payment of a reasonable purchase price. Purchasers have the right to fill to the bulkhead line or otherwise improve submerged land. Under section 12:3-6 no grant extending below the high water mark will be in force prior to payment or offer of security. According to section 12:3-7, unimproved submerged land may be granted or leased to the limits of exterior lines. The grantee may reclaim or improve the land. Grants are available to riparian owners only, unless six months have passed following notice of application by a non-riparian owner. Sections 12:3-7.1 allows applicants who are unable to give adequate notice to file with the Department of Conservation; and the Department may act to allow the grant. (Kelly-Fla)
W69-05348

TRESPASS ON LANDS OF STATE UNDERWATER AND CONVEYANCES BY COMMERCE AND NAVIGATION.

N J Stat Ann secs 12:3-8 to 12:3-12 (1968).

Descriptors: *New Jersey, *Riparian rights, *Riparian lands, *Tidal waters, Legislation, Beds under water, Ownership of beds, State governments, Landfills, Land reclamation, Navigable waters, Land tenure, Water law.

Identifiers: Commerce and Navigation Board, Kill von Kull, Department of Conserv and Econ Development.

Section 12:3-8 states that the Department of Conservation and Economic Development may institute civil actions against trespasses who unlawfully use or occupy submerged land or land heretofor under water. The Attorney General must prosecute such actions. Section 12:3-9 prohibits a non-riparian grantee from filling or improving land until the rights and interests of the riparian owner have been extinguished by the Department or through court action. Section 12:3-10 allows a riparian owner to apply to the Commerce and Navigation Board for a lease or grant of land under adjacent tidewaters. The Board has discretionary power to void any grant so made, with reversion of title to the state. Section 12:3-11 holds section 12:3-10 inapplicable to other prior sections dealing with New York Bay or Kill von Kull, east of Enyard's dock. Section 12:3-12 allows the Board, with the governor and attorney general, to include additional covenants and conditions in grants of land covered within 12:3-2 to 12:3-9, whether or not the land is presently underwater. (Kelly-Fla)
W69-05349

SURVEY OPERATIONS AND CONTROLS BY THE BOARD OVER SUBMERGED LANDS.

N J Stat Ann secs 12:3-13 to 12:3-20 (1968).

Descriptors: *New Jersey, *Ownership of beds, *Land tenure, *Rights-of-way, Legislation, Tidal waters, Islands, Shoals, Reefs, Navigable waters, Bulkhead lines, Docks, River basins, Basins, Riparian rights, Hudson River, Water law, Surveys.
Identifiers: *Commerce and Navigation Board, New York Bay.

Sections 12:3-13 to 12:3-20 concern state control of basins, rights-of-way, surveying and setting prices for submerged lands. Section 12:3-13 permits the Commerce and Navigation Board to alter pier lines, basins, or lines of solid filling in New York Bay or the Hudson River. Changes shall be filed with the secretary of state. Section 12:3-15 states that the Board may sell to riparian owners rights to use basins for docking, reserving the basins as public. Section 12:3-16 provides for the fixing of prices for land, now or formerly submerged. Section 12:3-17 permits the Board's extension of its surveys to all state tidewaters, as requested by riparian owners. Under section 12:3-18, where a right-of-way separates the upland of a riparian owner from the tidewater, he shall still be a riparian owner for purposes of state grants. Section 12:3-19 permits the Board to establish exterior lines around islands, reefs, and shoals in tidal waters, prohibiting obstructions beyond them. No grant prior to 1891 is affected. Section 12:3-20 allows submerged lands around islands, reefs, or shoals to be sold by the Board with the governor's consent. (Kelly-Fla)
W69-05350

USAGE OF SUBMERGED LAND; LEASE AND GRANT CONDITIONS AND PROCEDURE.

N J Stat Ann secs 12:3-21 to 12:3-28 (1968).

Descriptors: *New Jersey, *Legislation, *Riparian rights, *Reclamation, Dredging, High water mark, Riparian lands, Land tenure, Property boundaries, Basins, Tidal waters, Bridges, Pipelines, State government, Beds under water, Ownership of beds.
Identifiers: *Commerce and Navigation Board.

Section 12:3-21 prohibits removal or dredging of land under tidewaters without a license. However, a grantee or leasee of the state may make improvements by removal or dredging of sand or other material within the lines of, or in front of, such grant or lease. Section 12:3-22 allows the Commerce and Navigation Board and governor to grant licenses for dredging and digging under tidewaters. Section 12:3-23 allows the Board, with the governor's approval, to lease or grant land under the high water mark to non-riparian owners, provided proper notice is given. Section 12:3-24 states that the board need not execute leases which are convertible to grants (Section 12:3-5), but may sell or let under conditions deemed proper. Section 12:3-25 permits the Board and governor to provide for lease renewal and annual rentals. Laying pipes under the state's tidal waters without written permission from the government and Board is prohibited under section 12:3-26. Section 12:3-27 enables the Board to enlarge or reduce the area of any public basin, and may grant or lease reclaimed or filled land, provided adjacent riparian owners consent. Section 12:3-28 declares that the Board must approve plans by other agencies to build or alter bridges over tidal waters. (Kelly-Fla)
W69-05351

PROTECTION OF THE PALISADES.

N J Stat Ann secs 12:3-29 to 12:3-32 (1968).

Descriptors: *New Jersey, *Beds under water, *Real property, Legislation, Hudson River, High water mark, Tidal waters, Land use, Land tenure, Ownership of beds, Riparian rights, Riparian lands.
Identifiers: *Palisades.

Section 12:3-29 provides that any lease or grant of submerged land beneath the Hudson River adjacent to the Palisades must contain terms preserving the uniformity and continuity of the Palisades. Section 12:3-30 allows blasting and the removal of rock or similar operations between the Palisades and the highwater mark, when done for improvement purposes. Section 12:3-31 defines the boundaries of the Palisades by metes and bounds. Section 12:3-32 states that grants made south of the Palisades or before 1898 are not affected by section 12:3-29. (Kelly-Fla)
W69-05352

GRANTS OF SUBMERGED LANDS TO THE STATE, MUNICIPALITIES, AND OTHER SUBDIVISIONS.

N J Stat Ann secs 12:3-33 to 12:3-37 (1968).

Descriptors: *New Jersey, *Riparian rights, *Local governments, Legislation, State governments, Ownership of beds, Beds under water, Riparian lands, Navigable waters, Tidal waters, Water law, Bridges.
Identifiers: *Board of Commerce and Navigation.

Section 12:3-33 allows the Board of Commerce and Navigation to grant land under tidewaters to municipalities or other subdivisions upon application, where the latter creates a public park, street or highway on riparian land. Section 12:3-34 states that the grant (12:3-33) may be conditioned upon the maintenance of the riparian land as a public facility. Section 12:3-35 allows the Board to provide for construction of bridge by private corporations for municipalities or other subdivisions for extensions of streets over lands granted. Section 12:3-36 provides that if the applicant under section 12:3-33 is unable or unwilling to pay the price fixed, the Board may grant a revocable lease, charging a nonimal fee, until it decides upon reasonable compensation for the applicant (or a new grantee) to pay. Section 12:3-37 saves listed acts from repeal. Included are prior acts relating to leases and grants of riparian lands to municipalities for streets, highways, parks, and other public purposes. (Kelly-Fla)
W69-05353

CONFIRMATORY LEASES AND GRANTS OF SUBMERGED LAND.

N J Stat Ann secs 12:3-38 to 12:3-44 (1968).

Descriptors: *Ownership of beds, *Beds under water, *Land tenure, *Riparian rights, High water mark, Riparian lands, State governments, New Jersey, Equitable apportionment, Navigable waters.
Identifiers: *Commerce and Navigation Board.

Section 12:3-38 allows the Commerce and Navigation Board, upon request, to make confirmatory grants of submerged land to riparian owners who claim such land under prior grants. Section 12:3-39 permits the Board to execute conclusive confirmatory grants after an investigation. Further payment may be required. Section 12:3-40 states that a petitioner's request under 12:3-38 may include additional underwater lands adjacent to land to be covered in any confirmatory lease. Under sections 12:3-41 and 12:3-42, lands now, or formerly, under tidewaters are covered by this title. Any new or confirmatory grants may be based on original high water marks. Listed factors are to be considered by the Board; original consideration, apportionment by other agencies, equitable apportionment along irregular boundaries to provide reasonable deep water access, and petitioner's present right to riparian lands. Section 12:3-43 prohibits grants to anyone who is not a riparian owner. Section 12:3-44 states that sections 12:3-38 to 12:3-43 apply to all riparian owners. (Kelly-Fla)
W69-05354

ERRONEOUS GRANTS OF SUBMERGED LAND.

N J Stat Ann secs 12:3-45 to 12:3-47 (1968).

Descriptors: *New Jersey, *Land tenure, *Riparian rights, Legislation, Land use, Riparian lands, Tidal waters, State governments, Water law.
Identifiers: Commerce and Navigation Board.

Section 12:3-45 provides that a riparian owner must assert his pre-emptive rights within five years of an erroneous grant of submerged lands, adjacent to his property, made to a non-riparian owner, assuming the latter records his grant and makes improvements. Section 12:3-46 permits the Commerce and Navigation Board to convey the land in absolute fee to the grantee in error, if the affected riparian owner fails to object. Section 12:3-47 allows the Board to require additional reasonable compensation in making a grant under section 12:3-46. (E Kelly-Fla)
W69-05355

DELINQUENT RIPARIAN LEASES; RE-ENTRY BY THE STATE.

N J Stat Ann secs 12:3-48 to 12:3-47 (1968).

Descriptors: *New Jersey, *Beds under water, *Riparian rights, *Land tenure, Legislation, Ownership of beds, Real property, Land use, State governments, Administrative decisions.
Identifiers: *Riparian lessor, Commerce and Navigation Board.

Section 12:3-48 requires annual lists of all delinquent riparian leases to be submitted to the Commerce and Navigation Board. Sections 12:3-49 allow the Board to re-enter lands listed in 12:3-48 if the grant contains a covenant to that effect. Section 12:3-50 defines re-entry. Section 12:3-51 declares that notice by service or publication is a pre-requisite to re-entry, and section 12:3-52 sets forth contents of the notice. Section 12:3-53 requires the Board to report to the state treasurer that notice was given. Section 12:3-54 provides for delivery of the original lease by the treasurer to the Board. Section 12:3-55 requires a certificate of re-entry for repossession. Section 12:3-56 declares that state rights to unpaid rentals are unnaffected by re-entry, and section 12:3-57 releases treasurer from responsibility for the lease. (E Kelly-Fla)
W69-05356

MOORING AND FASTENING BOATS UPON RIPARIAN LANDS.

N J Stat Ann secs 12:3-58 to 12:3-63 (1968).

escriptors: *Riparian lands, *Riparian rights, New Jersey, Legislation, State governments, Beds nder water, Boats, Land usage.
dentifiers: *Mooring, Commerce and Navigation oard.

ection 12:3-58 provides that mooring, grounding, r fastening a boat, barge, or raft to, or upon, parian lands for a ten day period constitutes a uisance. Such action also constitutes a isdemeanor under section 12:3-59. Section 12:3-0 authorizes the Commerce and Navigation Board o remove the boat, barge, or raft after giving 48 ours notice, and to charge the owner with removal osts by placing a lien upon the vessel. Section 2:3-61 permits the Board to enforce the lien 2:3-60) by sale of the boat. Section 12:3-62 pro-des that proceeds of the sale to pay costs are to be rwarded to the state treasurer. Section 12:3-63 ates that nothing in this article will apply to ripari-n lands devoted to public parks. (E Kelly-Fla)
/69-05357

TATE ACQUISITION OF RIPARIAN LANDS; EASE FOR COMMERCIAL ENTERPRISES.

J Stat Ann secs 12:3-64 to 12:3-71 (1968).

escriptors: *New Jersey, *Land tenure, *Riparian nds, *Land usage, Legislation, State govern-ents, Beds under water, Ownership of beds, iparian rights, Condemnation, Legal aspects.

ection 12:3-64 allows the Department of conomic Development to acquire riparian lands y purchase, devise, or condemnation. Section 2:3-65 permits the Commerce and Navigation oard to lease or grant land taken under 12:3-64 or not longer than sixty years. Riparian lands must e granted only together with adjacent submerged nds. Section 12:3-66 permits the Board's con-eyance of the use of riparian land to the original wner for improvement by him, in consideration of tle transfer to the state. Section 12:3-67 allows the ssee under section 12:3-66 to operate a commer-ial enterprise under the Board's supervision. Sec-on 12:3-68 permits the Board to require a per-entage of the income of the enterprise in lieu of xed rent. Section 12:3-69 states that moneys eceived shall be treated as rents under applicable w. Section 12:3-70 requires that all improve-ents and title with goodwill of the business to evert to the state when the lease expires. Section 2:3-71 states that grants under this statute are sub-ct to applicable existing law. (E Kelly-Fla)
/69-05358

IORRIS CANAL AND BANKING COMPANY.
J Stat Ann secs 13:12-1 to 13:12-13 (1968).

escriptors: *New Jersey, *Diversion, *Water-ourses, *Easements, Legislation, Water levels, ecreation, Local governments, Canals, Lakes, onds, Streams, Railroads, Highways regulation, rants, Cities, Sewers, Sewer pipes, Legal aspects.
dentifiers: Morris Canal and Banking Company.

he corporate existence of the Morris Canal and anking Company is continued. The Morris Canal defined by this section. Title to property vested in e canal and banking company is held in trust for e state. The rights vested in the company to im-ound and divert waters of lakes, ponds, and reams and the rights in certain specified lakes are edicated to the public use of conserving the public aters and recreation. In operating dams and slu-es, the rights of riparian owners shall be con-rved. Title to shares of stock of the canal and anking company is transferred to the Department f Conservation and Economic Development. All roperty, title which is vested in the canal and anking company, shall continue to be managed nd controlled by that company. Grants may be ade to municipalities to lay and maintain sewer ipes under and along the canal right of way. Canal roperty may be sold to railroad companies to ake possible the construction of additional main racks. Abandoned portions of canal property are edicated as public highways. (Childs-Fla)
W69-05359

MORRIS CANAL AND BANKING COMPANY.

N J Stat Ann secs 13:12-14 to 13:12-24 (1968).

Descriptors: *New Jersey, *Diversion, *Bridges, *Operation and maintenance, Legislation, Water supply, Cities, Dams, Sluice gates, Regulation, Port of New York Authority, Legal aspects, Canals, Roads, Drainage.
Identifiers: Morris Canal and Banking Company.

The diversion, for the purpose of municipal water supply, of waters of the canal may be permitted. Canal property may be sold for road purposes. The canal and banking company may also sell canal property in municipalities to such municipalities or to the Port of New York Authority. Property outside municipalities may be sold to municipalities or at public or private sale. A municipality may subsequently resell any property acquired from the canal and banking company. As soon as the water has been drained off, bridges are to be removed and the beds filled by the company. All dams and sluice gates are to be maintained in a safe condition, obstructions to highways or watercourses are to be prevented, and proper drainage of the canal must be provided. A canal fund is established. Injuries to or destruction of canal property are punished by fine. (Childs-Fla)
W69-05360

DELAWARE AND RARITAN CANAL.
For primary bibliographic entry see Field 04A.
W69-05361

DRAINAGE AND FLOWAGE OF LANDS.
For primary bibliographic entry see Field 04A.
W69-05362

BEACH FRONTS AND WATERWAYS.
For primary bibliographic entry see Field 04A.
W69-05363

WATERWAYS AND WATER FRONTS.
For primary bibliographic entry see Field 04A.
W69-05364

PUBLIC PARKS - PLAYGROUNDS; SALE OF RECLAIMED LANDS ABUTTING PARK LANDS.

N J Stat Ann sec 40:61-22.2 (1967).

Descriptors: *New Jersey, *Land reclamation, *Cities, *Beds, Parks, Land use, Land classification, Land fills, Land ownership, Land management, Land appraisal, City planning, Legislation, Legal aspects, Bulkheads.

Whenever a municipality has reclaimed lands under water fronting or abutting park lands and such reclaimed lands have been bulkheaded and filled and are now used for park purposes, the municipality may sell and part or parts, parcel or parcels of parklands not so reclaimed whether contiguous or not contiguous to such reclaimed park lands; provided, that the total area of park land so sold shall not exceed in area the area of such reclaimed lands. (Carruthers-Fla)
W69-05365

WETLANDS (CONTROL AND REGULATION IN MAINE).
Me Rev Stat Ann tit 12, secs 4701-4709 (1968-69 Supp).

Descriptors: *Coastal marshes, *Permits, *Maine, Legislation, Legal aspects, Surface drainage, Dredging, Sewage, Cities, Wetlands, Bogs, Swamps, Regulations, Public benefits, Competing uses, Riparian rights, Water utilization, Railroads, Roads.
Identifiers: Railroad beds.

Parties seeking to dredge or drain sewage into, or otherwise alter any swamp, bog, marsh, beach or other wetland bordering coastal waters must file written notice with the affected municipality and with the state's controlling agency. Permits will then be issued subject to protection of public interest, and the interests of adjoining owners. Appeal from a denial or an issuance of a permit may be had in the superior court. The Wetlands Control Board is the controlling state agency and its composition is provided for in the act. Emergency action is allowed without a permit, provided notice is given. The Board may waive procedural requirements or exempt certain activities where such action is not inconsistent with the purposes of the act. Maintenance and repair of existing roads or railroad beds are not affected by the act, provided no watercourse is substantially altered. Willful violations of the permit requirement provisions may result in fines and injunctive restraint of continued violation by the superior court. (E Kelly-Fla)
W69-05366

UNPROTECTED WELLS.

Me Rev Stat Ann tit 17, secs 3901, 3902 (1965).

Descriptors: *Maine, *Wells, *Well regulations, *Barriers, Legislation, Legal aspects, Water supply, State governments.
Identifiers: Penalties (Criminal).

A 'well' is defined as a deep, narrow pit in the earth, usually walled, and used for the purpose of obtaining a supply of water. All open wells shall be surrounded by a substantial fence or other enclosing barrier. Coverings which can be securely fastened may also be used. Violation of this section carries a fine or not more than $50 or imprisonment for not more than 30 days, or both. (Logan-Fla)
W69-05367

REMOVAL OF BUSHES, TREES, AND STUMPS FROM FLOWED AREA.
For primary bibliographic entry see Field 04A.
W69-05368

NUISANCES-MILLS AND DAMS; FENCES AND BUILDINGS ON PUBLIC WAYS.
For primary bibliographic entry see Field 04A.
W69-05369

DUMPING OF OIL.
For primary bibliographic entry see Field 05G.
W69-05370

DAMAGE TO ICE.

Me Rev Stat Ann tit 17, sec 2500 (1965).

Descriptors: *Maine, *Legislation, *Ice, Legal aspects, State governments, Ponds, Lakes, Damages.

Whoever will fully or maliciously cuts, injures, or otherwise damages ice upon waters from which ice is or may be taken as an article of merchandise, shall be punished by a fine of not more than $500 or imprisonment for not more than 11 months. (Logan-Fla)
W69-05371

TAKING OF WATERCRAFT, AIRCRAFT OR DRAFT ANIMALS; INJURING OR CUTTING LOOSE BOOMS, RAFTS, VESSELS OR BOATS; CIVIL ACTION FOR DAMAGES.
Me Rev Stat Ann tit 17, secs 2498, 2499 (1965).

Descriptors: *Maine, *State governments, *Boats, *Lumbering, Legislation, Legal aspects, Aircraft.
Identifiers: Double damages, Penalties (Criminal), Penalties (Civil).

Whoever willfully and mischievously takes or uses any boat, vehicle, or airplane which is the property of another, without the consent of the owner, shall be fined not more than $300 or imprisoned for not more than 11 months. Whoever, not being the owner, willfully and maliciously cuts away, lets loose, injures, or destroys any raft, boom, logs or other lumber, or any vessel, gondola, scow or other boat shall be fined not more than $500 and imprisoned not exceeding 1 year. The wrongdoer shall also be civilly liable for double damages. (Logan-Fla)
W69-05372

MOORING WATERCRAFT TO BUOYS OR BEACONS.

Me Rev Stat Ann tit 17, sec 2497 (1965).

Descriptors: *Legislation, *Buoys, *Boats, *Navigable waters, Maine, Legal aspects, State governments, Federal government, Navigation, Warning systems.
Identifiers: *Beacons, Mooring, Penalties (Criminal).

Made illegal is the mooring of any vessel, boat, scow or raft to any buoy or beacon placed by the United States or by the State of Maine in any of Maine's navigable waters. Punishment for violation of this provision is a fine of $50. Willful destruction of any such buoy or beacon results in a forfeiture of $100 and imprisonment for 3 months. (Logan-Fla)
W69-05373

MALICIOUS MISCHIEFS-PUBLIC UTILITIES.
For primary bibliographic entry see Field 04C.
W69-05374

NOTICE OF PETITIONS FOR SPECIAL LEGISLATION PERTAINING TO FISH AND GAME.

Me Re State Ann tit 3, sec 125 (1965).

Descriptors: *Maine, *Wildlife, *Fish, *Game birds, Legislation, State governments, Legal aspects.
Identifiers: *Notice, Petitions, Special legislation.

Notice of petitions, bills, or resolves for special legislation, regarding or pertaining to fish or game, with full description of the territory or waters affected by such legislation is required. Furthermore, such notice shall run for 8 consecutive weeks in some weekly publication nearest the locality affected by the proposed legislation. The last notice shall not be less than one nor more than three weeks before the assembling of the legislature. (Logan-Fla)
W69-05375

UNWHOLESOME PREMISES; REMOVAL AND REHABILITATION AT OWNER'S EXPENSE.
For primary bibliographic entry see Field 05B.
W69-05376

HARBORS, WHARVES, AND HARBOR MASTERS.
For primary bibliographic entry see Field 04A.
W69-05377

HIGHWAYS.
For primary bibliographic entry see Field 04C.
W69-05378

HIGHWAYS.
For primary bibliographic entry see Field 04C.
W69-05379

PENN CENTRAL CO V BUCKLEY AND CO (BRIDGE COLLISIONS SUIT).

293 F Supp 653-660 (D N J 1968).

Descriptors: *New Jersey, *Judicial decisions, *Bridges, *Accidents, Railroads, Navigable rivers, Damages, Ships, Channels, Navigation.

Plaintiffs owned and maintained a railroad drawbridge across a navigable river. Defendant operated tows hauling scows which passed beneath the bridge regularly in its normal course of operations. On several occasions defendant's tows, while hauling more than one scow, struck the bridge fenders inflicting considerable damage. Plaintiffs sought an injunction to restrain the defendant from operating tows with more than one scow. In denying relief, the court stated that plaintiffs had an adequate remedy at law. As a matter of law the evidence was not sufficient to show that only one-scow tows could safely cross beneath the bridge. The plaintiffs did not show that irreparable damage will result if the injuction is not granted. (Molica-Fla)
W69-05380

POIRE V SERRA (PROPRIETY OF LAND FILL BY RIPARIAN OWNER).
For primary bibliographic entry see Field 04A.
W69-05381

JOHNSON V RAY (RIGHT TO CONSTRUCT RETAINING WALL)
For primary bibliographic entry see Field 04A.
W69-05382

WATERS OF WHITE LAKE INC V FRICKE (OWNERSHIP OF LAKE BEDS).
282 App Div 333 123 NYS 2d 400-410 (1953).

Descriptors: *New York, *Ownership of beds, *Boundaries (Property), *Riparian rights, Ponds, Reasonable use, Public benefits, Easements, Judicial decisions, Legal aspects, Lakes, Real property, Beds, Riparian lands, Remedies.
Identifiers: Rebutable presumptions, Injunctions (Mandatory).

laintiff sought to enjoin use of a summer resort lake under which he owned a substantial portion of the bed. The court recognized that a very strong presumption exists in New York that a conveyance of land bounded by a small inland lake carries title to the center of the lake unless an intention to the contrary is expressly manifested in the instrument of conveyance. In the present case, the language concerning the extent of defendant's grant was somewhat ambiguous, but the court required the plaintiff to demonstrate that his title to the lake bed was sufficient to support the relief sought. The plaintiff could only demonstrate title to a substantial portion of the lake bed, and the court recognized that the portion so held was intersected by four triangular sections of bed held by third parties. This fragmentation of the plaintiff's interest made injunctive relief impracticable and unworkable. Therefore, plaintiff's request was denied. (Katz-Fla)
W69-05383

CITY OF HARDIN V NORBORNE LAND DRAINAGE DISTRICT (STATUTORY RIGHTS TO MAINTAIN EXISTING LEVEES).
For primary bibliographic entry see Field 04A.
W69-05384

REYNOLDS METAL CO V BALL (SUIT TO RECOVER DAMAGES FOR ALLEGED DEPOSIT OF SEDIMENT CONTAINING POISONOUS SUBSTANCES).
For primary bibliographic entry see Field 05C.
W69-05385

TENNESSEE VALLEY SAND AND GRAVEL CO V PILLING (LIABILITY FOR SEDIMENT DUMPING WHICH MAKES CREEK BED SHALLOWER, WHICH CAUSES MORE FLOODING).
For primary bibliographic entry see Field 05G.
W69-05386

GARGAC V SMITH-ROWLAND CO (POLLUTION OF LAKE BY INDUSTRIAL WASTES).
For primary bibliographic entry see Field 05C.
W69-05387

TRUSTEES OF FREEHOLDERS AND COMMONALTY V MORRISEY (TITLE TO BEDS UNDER TIDAL WATERS).

191 Misc 920, 83 N Y S 2d 681-686 (S C 1947).

Descriptors: *New York, *Tidal waters, *Beds under water, *Ownership of beds, Judicial decisions, Legal aspects, Water law, Fishing, Shellfish Bays, Patents, Allotments, Boundaries (Property), Beds.
Identifiers: *Long Island, Penny Pond, Shinnecock Bay, Ejectment.

Plaintiffs brought an ejectment action against defendant, seeking to recover possession of lands under the waters of Penny Pond, an eight acre body of water on the north side of Shinnecock Bay. Plaintiffs' chain of title originated in certain English patents issued in 1676 and 1686. Defendant claimed title by virtue of an allotment by town trustees in 1738 which described the property only in general terms. Furthermore, no individual had asserted ownership for more than 200 years following the allotment. The court held that plaintiffs were entitled to judgment. The representatives of the trustees had never intended to deed to individuals any lands under water. The history of other Long Island towns indicated that tidewaters were for the use and benefit of all the residents of the various towns. The fact that defendant's title depended upon a general description of the pond and that no claim had been made by an individual for over 200 years merely gave additional credence to plaintiffs' claim. (Holt-Fla)
W69-05388

GREEN V MCCLOUD (ACTION TO ENJOIN SEWAGE FLOW).
For primary bibliographic entry see Field 05G.
W69-05389

ENDERSON V KELEHAN (UPLAND DRAINAGE OF SURFACE WATERS).
For primary bibliographic entry see Field 04A.
W69-05390

BURT V MUNGER (EROSION CONTROL AND LANDFILL BY RIPARIAN OWNER).
For primary bibliographic entry see Field 04A.
W69-05391

TURNER V SMITH (RESERVOIR OBSTRUCTING LAND DRAINAGE).
For primary bibliographic entry see Field 04A.
W69-05392

DODD V BLEZEK (DETERMINATION OF DOMINANT ESTATE AND DRAINAGE RIGHTS IN NATURAL STREAM).
For primary bibliographic entry see Field 04A.
W69-05393

JOHNSON V CITY OF WINSTON-SALEM (ACTION FOR DAMAGES CAUSED BY AN OBSTRUCTED DRAIN PIPE).
For primary bibliographic entry see Field 04A.
W69-05394

BOAT V VAN VEEN (INTERFERENCE WITH WATER FLOW).
For primary bibliographic entry see Field 04A.
W69-05395

CICONTE V SHOCKLEY (RUNOFF NUISANCE).
For primary bibliographic entry see Field 04A.
W69-05396

LUCAS V FORD (EASEMENT - SURFACE WATER DRAINAGE).
For primary bibliographic entry see Field 04A.
W69-05397

HOLDA V PITTSBURGH FORGINGS CO LANDFILLS AND OWNERSHIP OF BEDS).

25 Mich 682, 39 NW 2d 221-226 (1949).

Descriptors: *Michigan, *Ownership of beds, Boundaries (Property), *Ponds, Landfills, Riparian land, Riparian rights, Reasonable use, Legal aspects, Judicial decisions, Banks, Mill dams, Prescriptive rights, Beds.
Identifiers: Ejectment.

Plaintiffs sought to eject defendant from certain filled land abutting on plaintiffs' property and extending into a mill pond which constituted a boundary of the plaintiffs' property. The fill operation was conducted by the plaintiffs, and they claimed title to such fill-land by virtue of riparian ownership. The defendant contends that plaintiffs' deed did not convey riparian rights to the plaintiffs since title to the mill pond remained at all times in the plaintiffs' grantor, the successor in title of the defendant. The court examined the plaintiffs' title and determined that plaintiffs were not riparian owners. The court also recognized the fact that even if plaintiffs had demonstrated ownership of the pond bed, their claim that the right to fill such bed was an incident of riparian ownership would undoubtedly have been disallowed. (Katz-Fla)
W69-05398

ADKISSON V STARR (TITLE TO ACCRETION).

260 SW 2d 956-960 (Ark 1953).

Descriptors: *Riparian rights, *Boundaries (Property), *Accretion (Legal aspects), *Arkansas, Bank erosion, Avulsion, Legal aspects, Judicial decisions, State jurisdiction, Erosion, Streams, Banks, Riparian land, Remedies.

Adjoining riparian landowners brought suit to obtain a division of land that was formed by accretion as the channel of the Arkansas River gradually shifted westward. The chancellor below divided the new land by extending the common boundary due west across the area in controversy. The appellants, defendants below, contend that all the disputed acreage became their property by accretion or, if not, then they have acquired title by adverse possession. The appellant claims that a shift in the course of a creek, on the appellee's land, in such a manner as to parallel the Arkansas River rather than empty directly into it, had the effect of cutting the appellee, and his rights, off from the accreted land. The court found that an argument identical to the appellant's had previously been rejected in Arkansas, and the court adhered to this precedent. The appellant's claim to adverse possession was founded on the appellee's failure to exercise dominion over the land. However, the appellant's proof was found to be insufficient to support his claim to ownership. The judgment of the court below in favor of the appellee was affirmed. (Katz-Fla)
W69-05399

COUNTY COMMISSIONERS OF BALTIMORE COUNTY V HUNTER (DRAINAGE EASEMENT NUISANCE).
For primary bibliographic entry see Field 04A.
W69-05400

WATER SUPPLY PROBLEMS IN DEVELOPING COUNTRIES,
International Bank for Reconstruction and Development, Washington, D. C.
For primary bibliographic entry see Field 03D.
W69-05513

CAPITAL FORMATION AND GOVERNMENT CAPITAL POLICY IN DEVELOPING ECONOMIES,
Tel Aviv Univ. (Israel).
For primary bibliographic entry see Field 06C.
W69-05518

WATER RESOURCES LAW IN VIRGINIA.
William R. Walker, and William E. Cox.
Water Resources Law in Virginia, Bulletin 9, Aug 1968. 181 p, 412 ref, 1 fig.

Descriptors: *Natural streams, *Percolating water, *Surface runoff, *Tidal waters, Confined waters, Virginia, Publications, Water law, Legal aspects, Water sources, Riparian rights, Diversion, Pollution, Obstruction to flow, Dams, Ownership of beds, Navigation, Eminent domain, Underground streams, Tidal waters, Ponds, Lakes, Water works, Sewage systems, Remedies.

This is a compilation of the water resources laws of Virginia. It covers the state constitution, the Code of Virginia, the reports of the Virginia Supreme Court of Appeals, and other literature. The purpose of this summary is to provide a comprehensive look at the existing legal rules relating to water resources. It is hoped that this work may serve as a basis for determining what future adjustments might be made in an effort to resolve existing problems. Water rights, as they now exist, are dealt with in five spearate sections. The first four sections of the report deal with water in its natural state. Separate bodies of law are presented for natural watercourses, percolating ground water, and diffused surface water. Underground watercourses, tidal waters, lakes, and springs are all considered in the same section because the law applicable to each is basically similar to one or a combination of the three major doctrines. The law applicable to water subjected to various conditions of artificial confinement is presented separately because the rights in such water vary from those pertaining to water in its natural state. (Childs-Fla)
W69-05533

WATER RESOURCES LAWS IN VIRGINIA (NATURAL SURFACE WATERCOURSES).
William R. Walker, and William E. Cox.
Water Resources Law in Virginia, Bulletin 9, Aug 1968, 181 p, 412 ref, 1 fig.

Descriptors: *Natural streams, *Riparian rights, *Natural flow doctrine, *Ownership of beds, Virginia, Publications, Water law, Legal aspects, Water sources, Water rights, Reasonable use, Riparian land, Diversion, Pollution, Water quality, Public rights, Standards, Sewage, Industrial wastes, Obstruction to flow, Flood protection, Docks, Ownership of beds, Navigation, Eminent domain.

Under the Virginia statutes, 'watercourse' means a natural channel having a well defined bed and banks and in which water flows when it normally does flow. The riparian doctrine, with statutory modifications, governs the use of Virginia's watercourses. Generally, a riparian owner may divert water for any reasonable purpose not inconsistent with the reasonable use of other riparian owners. Both the riparian doctrine and statutory law control the preservation of the quality and purity of the state's watercourses. A combination of common law and statutory enactments control obstructions in watercourses; the applicability of a particular legal principle is dependent upon the type of obstruction and the nature of the watercourse involved. The right to use the bed of a stream depends upon the navigability of the stream and the ownership of the bed. Navigation rights are public rights and are paramount. Riparian rights generally pass with title to the riparian land, however, they may be conveyed separately. There are two exceptions to the riparian doctrine: (1) under the mill dam acts, the first locator on a stream has the superior right; (2) certain waters of the James River. (Childs-Fla)
W69-05534

WATER RESOURCES LAWS IN VIRGINIA (PERCOLATING GROUNDWATER - DIFFUSED SURFACE WATER).
William R. Walker, and William E. Cox.
Water Resources Law in Virginia, Bulletin 9, Aug 1968, 181 p, 412 ref, 1 fig.

Descriptors: *Percolating water, *Underground streams, *Surface waters, *Impounded waters, Surface runoff, Virginia, Publications, Water law, Legal aspects, Water sources, Water rights, Riparian rights, Reasonable use, Obstruction to flow, Railroads.

Percolating groundwater is all groundwater which does not flow in a known and defined channel. This definition includes all underground waters. There are two accepted doctrines governing rights to percolating waters: (1) absolute ownership; (2) reasonable use. At present, the only generally accepted legal principle concerning the use of percolating water is that any reasonable, legitimate use of one's land which interferes with the flow of percolating waters to another's land produces no liability. However, the modern trend is toward acceptance of the reasonable use doctrine. Diffused surface water normally means water which spreads over the surface of the ground without confinement in a bed or banks. Virginia purports to follow the 'common enemy' doctrine which permits each landowner to fight off surface waters as best as he can. However, there are certain exceptions to this doctrine. The legal principles applicable to underground watercourses are almost identical to those which apply to surface watercourses. The primary difference concerns the requirements for establishing the existence and location of an underground watercourse. (Childs-Fla)
W69-05535

WATER RESOURCES LAW IN VIRGINIA (OTHER WATER SOURCES).
William R. Walker, and William E. Cox.
Water Resources Law in Virginia, Bulletin 9, Aug 1968, 181 p, 412 ref, 1 fig.

Descriptors: *Water sources, *Riparian rights, *Tidal waters, *Pollution, Ownership of beds, Virginia, Publications, Water law, Legal aspects, Water rights, Consumptive use, Navigation, regulation, Fisheries, Beds, Shellfish, Harbors, Lakes, Springs.

Rights in tidal waters are governed by the same legal principles applicable to water rights in publicly owned watercourses. However, in the case of tidal waters the emphasis is on nonconsumptive uses. The pollution of tidal waters is controlled by the State Water Control Board. Principles of common law which protect private reights from injury by pollution differ from those relating to pollution of watercourses. The right of fishery in the tidal waters is subject to absolute control and regulation by the legislature. As in the case of public watercourses, the private ownership of property and the exclusive rights of use which depend on ownership extend to the low water mark for tidal waters. Jurisdiction over the ports of the state is vested in the Virginia State Ports Authority. The definition of a lake is similar to that of a watercourse, and the applicable legal principles are generally the same.

Because of the physical nature of springs, the law applicable thereto is a combination of both surface and groundwater doctrines. (Childs-Fla)
W69-05536

WATER RESOURCES LAW IN VIRGINIA (ARTIFICALLY CONFINED WATER).
For primary bibliographic entry see Field 02H.
W69-05537

WATER RESOURCES LAWS IN VIRGINIA (REMEDIES FOR INFRINGEMENT OF WATER RIGHTS).
William R. Walker, and William E. Cox.
Water Resources Law in Virginia, Bulletin 9, Aug 1968, 181 p, 412 ref, 1 fig.

Descriptors: *Remedies, *Hydrologic cycle, *Permits, *Inter-basin transfers, Ownership of beds, Virginia, Publications, Legal aspects, Water sources, Water rights, Riparian rights, Damages, Regulation, Groundwater, Planning, Legislation.
Identifiers: Statute of limitations.

The recommendations point out deficiencies in the area of water rights and their adjudication. Feasible alternatives proposed are general in nature and are not designed as an outline for specific legislation. (1) The law should recognize the interrelationships between water in the different phases of the hydrologic cycle. (2) There is need for a state agency to administer water rights. (3) A permit system would greatly facilitate the administration of water rights. (4) The rights concerning inter-basin transfers of water should be determined. (5) The ownership of the beds of the waters of the state and of certain lands bordering these waters should be defined. (6) Rights in groundwater should be developed more fully. (7) The over-all effect of any proposed water resource legislation on the total body of water law should be considered before such legislation is enacted. (Childs-Fla)
W69-05538

COMPLETION OF THE FAIRFAX COUNTY WATER AUTHORITY ACQUISITION PROGRAM.
Fairfax County Water Authority, Annandale, Va.
For primary bibliographic entry see Field 03D.
W69-05539

UNITED STATES V STATE OF LOUISIANA (STATE OWNERSHIP OF SUBMERGED, CONTIGUOUS LANDS).

U S, 89 S Ct 768-773, L Ed 2d (1969).

Deseriptors: *Texas, *Submerged Lands Act, *Coastlines, *Boundary disputes, Property boundaries, Legislation, Accretion, Bank erosion, Mineral industry, Gulf of Mexico, Jetties, Leases, Submerged lands, Ownership of beds, Judicial decisions, Legal aspects, State governments, United States, Federal government.

Plaintiff brought action against several states bordering on the Gulf of Mexico to determine the correct boundary lines of contiguous, submerged lands. The 1953 Submerged Lands Act granted to Texas a nine mile belt of submerged lands in the Gulf of Mexico. Texas measured these nine miles from its coastal boundaries as those boundaries which existed in 1845, the year Texas was admitted to the Union. Plaintiff contends that the nine mile strip should be measured from the Texas coastline as it exists today. The adoption of this method of measurement would play havoc with underwater mineral leases because erosion has considerably altered the coastline from what it was in 1845. Nevertheless, the court, after a careful reading of the Act and complimentary legislative enactments, held for the plaintiff and required Texas to use its modern-day coastline as the measuring boundary. (Stewart-Fla)
W69-05540

TENNESSEE GAS TRANSMISSION CO V GREATER LAFOURCHE PORT COMMISSION (DAMAGE FOR FORCED LOWERING OF PIPELINE ACROSS NAVIGABLE STREAM).
293 F Supp 1019-1025 (E D La 1968).

Descriptors: *Louisiana, *Compensation, *Navigable waters, *Eminent domain, Channels, Permits, Dredging, Right-of-way, Open channels, Pipelines, Easements, Legal aspects, Judicial decisions, Relative rights, Land tenure, Prescriptive rights.

Plaintiff gas company brought this action against defendant port commission, charging that the commission had forced plaintiff to incur the expense in lowering plaintiff's pipeline. The pipeline extended across a navigable watercourse. Defendant had not compensated plaintiff for this expenditure. Plaintiff had purchased a right-of-way from the State of Louisiana and the right to construct a pipeline across the watercourse from a private land company. Defendant, a Louisiana state commission, later decided to deepen and widen the watercourse and directed plaintiff to lower its pipeline accordingly. Plaintiff admitted liability under a prior argument for the expense of lowering that part of the pipeline which was in the main channel, but contended that defendant should pay for the relocation of that part outside the channel. The court found, however, that the lowering of the pipeline within the channel necessitated the adjustment of the rest of the pipeline, and that the two expenditures were inseparable. Plaintiff, therefore, was responsible for the entire amount, and the forced expenditures did not constitute a 'taking' without compensation. (Kelly-Fla)
W69-05541

MEYER V CITY OF OAKLAND (VALIDITY OF SPECIAL ASSESSMENTS TO LAND FOR SEWER IMPROVEMENTS).
219 So 2d 417-420 (Fla 1969).

Descriptors: *Florida, *Assessments, *Legal aspects, *Cost-benefit ratio, Sewerage, Real benefits, Estimated benefits, Cities, Local governments, Judicial decisions, Remedies, Land tenure, Public benefits, Public health, Construction costs.
Identifiers: *Square footage assessment.

The city of Oakland Park resolved to construct a sewer project to promote health and welfare. Of the total cost, $500,000 was to be obtained by special assessment against benefitting properties. Assessments were made on a square footage basis under the applicable state statute (Fla Stat sec 170.02). Certain large tract owners sought invalidation of the assessment certificates on the ground no increase in value of their lands would result from the improvements. The circuit court validated the certificates. The Supreme Court of Florida held on appeal that if square footage assessment approximately coincides with benefit apportionment it should be sustained. The court held benefit was a result of factors such as increase in market or utility value of property; benefit to the locality as a whole; and desirability of land for commercial or residential improvement. Benefit may include actual or future enhancement of value. The presumption is that the city and trial judge were correct in finding benefit. The presumption must be overcome by clear evidence to the contrary. The court held the landowners had not overcome the presumption of benefit, and the validation was affirmed. (Harris-Fla)
W69-05542

DESTEFANO V MEGLIO (DAMAGES FOR OBSTRUCTION OF A DRAIN).

64 Pa D AND C 599-609 (C P Pa 1948).

Descriptors: *Prescriptive rights, *Runoff, *Obstruction to flow, *Drains, Flood damage, Pennsylvania, Judicial decisions, Rain water, Easements, Barriers, Pipes, Real property, Legal aspects.
Identifiers: Rainspout, Flumen, Equity, Injunctions (Prohibitory).

Plaintiff sought to enjoin defendants, from blocking or obstructing the rain water drainage from her balcony to their roof, and asked for damages for injuries already sustained from such blockage. The question was whether or not the palintiff had an easement by prescription which enabled her to discharge rain water through a pipe from her balcony onto her neighbor's roof, despite any damage which might be caused thereby. The court held that plaintiff had obtained an easement. A rainspout which is open to the air and the operation of which is continuous and notorious in every rain can become an apparent easement, and, if used adversely for over 21 years, its use thereafter cannot be interfered with. Defendant's obstruction of the drain was enjoined, and damages were awarded to plaintiff. (Childs-Fla)
W69-05543

RAU V WILDEN ACRES, INC (ACCUMULATION-RIDDANCE).
For primary bibliographic entry see Field 04A.
W69-05544

NEWTON V LYONS (COMMON ENEMY EXCEPTION).

90 NE 2d 917-920 (Ind Ct App 1950).

Descriptors: *Indiana, *Riddance (Legal aspects), *Runoff, *Repulsion (Legal aspect), Precipitation excess, Drainage water, Surface waters, Surface drainage, Overland flow, Rain water, Ditches, Pipes, Tiles, Culverts, Roads, Highways, Roadbanks, Graded, Judicial decisions, Legal aspects, Flooding, Easements, Remedies, Backwater.

The plaintiff brought this action for an injunction to restrain defendant, Newton, from maintaining an alleged nuisance--the obstruction of a culvert under a roadbed. The parties had an agreement whereby a tile drainage system was constructed at mutual expense to carry off in a regular manner, the surface and drainage waters naturally flowing from the plaintiff's land. This program was facilitated by the intersection of the parties property by a state highway, the roadbed of which was intersected by a 24 inch culvert allowing the surface waters to collect and pass through the defendant's property. The defendant reduced the culvert opening to 12 inches on his side of the highway causing subsequent water backup into the palintiff's basement. The defendant contended that his conduct was lawful in that surface water, as a common enemy, may be repelled by a lower proprietor. The court found the defendant's conduct to have violated a qualification of the common enemy doctrine in that he had artificially accumulated the waters cast onto plaintiff's land. (Katz-Fla)
W69-05545

LAWRENCE V EASTERN AIRLINES (DIVERSION OF NATURAL FLOW).
For primary bibliographic entry see Field 04A.
W69-05546

DROGMILLER V OLSON (OBSTRUCTION TO NATURAL COURSE OF DRAINAGE).
For primary bibliographic entry see Field 04A.
W69-05547

LOCH SHELDRAKE ASSOCIATES V EVANS (RESTRICTIVE CLAUSE ON THE USES OF WATER).
280 App Div 51, 111 NYS 2d 365-371 (1952).

Descriptors: *New York, *Water rights, *Easements, *Water utilization, Judicial decisions, Consumptive use, Reasonable use, Lakes, Powerplants, Riparian rights, Natural use, Non-consumptive use, Hydroelectric power.
Identifiers: Restrictive covenants, Equitable servitudes.

Plaintiff brought suit to determine the right of the defendant to use water from a lake owned by the plaintiff. The trial court held that the defendant could use the water solely for purposes of generating power. However, the appellate court reversed, pointing out that the terms of a grant for the use of water will in all doubtful cases be construed as a limitation on quantity rather than a restriction as to use. No restriction as to use will be implied unless the circumstances clearly indicate such to have been the intent of the parties. The court looked to the construction of a reservation which the plaintiff put in a deed to a purchaser several years before the defendant took title. That restriction was similar to the one presently imposed on the defendant. The prior restriction was construed to be a limitation upon quantity, not a restriction on use and the prior purchases were allowed to use the water for general purposes as well as for power. The court interpreted the restriction imposed on defendant as carrying similar burdens. (Stewart-Fla)
W69-05548

TOWN OF VIENNA V STATE (PRESCRIPTIVE RIGHTS DOCTRINE AS APPLIED TO PUBLIC PROPERTY).
For primary bibliographic entry see Field 04A.
W69-05549

BUDA V STATE (ARTIFICIAL CONTROL OF SURFACE WATERS).
For primary bibliographic entry see Field 04A.
W69-05550

BOBO V YOUNG (ARTIFICIAL DRAINAGE OF SURFACE WATERS AND NATURAL FLOW).
For primary bibliographic entry see Field 04A.
W69-05551

PETERSON V WISCONSIN RIVER POWER CO (PROPERTY ENCROACHMENT BY IMPOUNDED WATERS).
For primary bibliographic entry see Field 04A.
W69-05552

MASONITE CORPORATION V GUY (FISHKILL: EFFECTS OF WATER POLLUTION).
For primary bibliographic entry see Field 05C.
W69-05553

COATES V UNITED STATES (TAKING OF PROPERTY FOR PUBLIC PURPOSE WITHOUT JUST COMPENSATION).
For primary bibliographic entry see Field 04A.
W69-05554

STATE SQUIRE V CITY OF CLEVELAND (FILL LAND AND HIGHWAY USE AS TO LITTORAL RIGHTS).
For primary bibliographic entry see Field 04C.
W69-05555

DEYO V ATHOL HOUSING AUTHORITY (DAMAGE FROM WATER DISCHARGE).
For primary bibliographic entry see Field 04C.
W69-05556

GWINN V MYERS (SUIT TO REMOVE OBSTRUCTION TO NATURAL WATERCOURSE).
For primary bibliographic entry see Field 04A.
W69-05557

EL PASO WATER IMPROV DIST NO 1 V CITY OF EL PASO (RIGHT OF REMOVAL UNDER WATER SUPPLY CONTRACT).

243 F 2d 927-934 (5th Cir 1957).

Descriptors: *Water rights, *Cities, *River basin commissions, *Contracts, Federal government, Judicial decisions, Navigable rivers, Municipal water, Relative rights, Benefits, Legal aspects, Permits, Rio Grande, Right of way, Effluents.

Plaintiff, joined by the United States, sued defendant city in an effort to determine their respective rights in the waters of the Rio Grande River. The defendant city had sometime previously deeded all its right, title, interest, and right of way along an adjacent canal. This canal was contiguous to the Rio Grande and became part of the land managed by the plaintiff water improvement district. The plaintiff district and the defendant had entered into a contract which gave the city the right to take water from the river in excess of the district's needs. The defendant dumped salvageable effluent back into the river; the controversy centered about the ownership of this effluent. The city had no equitable basis to support its view that it was entitled to remove as much water from the river as it added (effluent) to it. Since the city accepted the contract and had accepted its benefits, it now could not contend that it was entitled to more water than provided therein or that the contract was a nullity. (Blunt-Fla)
W69-05558

W B RODDENBERY CO INC V CARTER (DAMAGES FOR POLLUTION OF STREAM).
For primary bibliographic entry see Field 05B.
W69-05559

REESE V STATE (DAMAGE TO LAND DUE TO DIVERSION OF STREAM).
For primary bibliographic entry see Field 04A.
W69-05560

CLARK V GIFFORD-HILL AND CO (WATER POLLUTION BY MINING).
For primary bibliographic entry see Field 05G.
W69-05561

CORNETT V HEBERT (OBSTRUCTION TO FLOW OF SURFACE WATER).
For primary bibliographic entry see Field 04A.
W69-05562

BRAY V CITY OF WINTER GARDEN (SURFACE WATERS CAST ON LOWER PROPERTY).
For primary bibliographic entry see Field 04A.
W69-05563

NAVIGABLE STREAMS, PERMISSION TO BRIDGE OR DAM; PUBLIC SERVICE FACILITIES; NATURAL RESOURCES.
Mich Const art 7, sec 12; art 7, sec 24; art 4, sec 52.

Descriptors: *Michigan, *Conservation, *Navigable waters, *Utilities, Dams, Bridges, Pollution, Water supply, Sewage disposal, Natural resources, Water policy, Water resources, Water resources development.
Identifiers: *Constitutions.

The conservation and development of the state's natural resources is declared to be of paramount public concern, and the legislature shall provide for protection of all natural resources from pollution, impairment and destruction. Navigable streams shall not be bridged or dammed without permission of the county board of supervisors in the interests of the county. Any city or village may operate and own water, sewage disposal, or any other public service facility within or without its corporate limits, and may sell and deliver such service outside its corporate limits. (Harris-Fla)
W69-05564

SALT WATER ISLANDS.

Me Rev Stat Ann tit 14, sec 7556 (1965).

Descriptors: *Maine, *Hunting, *Wildlife, *Islands, Legislation, State governments, Birds, Game birds, Saline water, Civil law, Damages, Legal aspects.
Identifiers: Penalties (Civil).

Whoever, after having notice, trespasses upon any island within salt waters, for the purpose of shooting or hunting thereon, is liable to the owner, occupant, or lessee of the island. Exemplary damages shall be not less than $20 nor more than $50 in addition to all actual damages sustained; $5 shall be assessed for every bird of any kind shot, caught, taken or killed. (Logan-Fla)
W69-05565

TRESPASS - IMPROVED LANDS AND FISH PONDS.

Me Rev Stat Ann tit 17, sec 3852 (Supp 1968-69).

Descriptors: *Maine, *State governments, *Fish, *Game birds, Legislation, Legal aspects, Fish stocking, Ponds, Pastures, Vegetation.
Identifiers: Penalties (Criminal).

Whoever commits a trespass upon any garden, pasture, orchard, or pond used for the lawful cultivation of fish or as a commercial shooting area, with intent to take, carry away, or destroy flowers, plants, grain, fish, quail, pheasants, or Chukar partridge, shall be punished by fine of not more than $100 and by imprisonment for not more than 90 days. (Logan-Fla)
W69-05566

MORRIS V WINTERS (ACTION TO REMOVE AN OBSTRUCTION TO WATER FLOW).
For primary bibliographic entry see Field 04A.
W69-05567

LEIPER V HEYWOOD-HALL CONSTR CO (CLAIM OF ARTIFICIALLY INCREASED DRAINAGE ON PART OF UPPER LANDOWNER).

381 Pa 317, 113 A 2d 148-150 (1955).

Descriptors: *Pennsylvania, *Reasonable use, *Drainage, *Artificial use, Surface waters, Surface runoff, Slopes, Drainage practices, Water conveyance, Relative rights, Judicial decisions, Legal aspects, Alteration of flow, Natural flow, Discharge, Channel flow.

Plaintiff, a lower landowner, contended that defendant construction company had, in the course of building a housing subdivision on higher land adjacent to plaintiff's property, collected surface water and artificially channeled it onto plaintiff's land in substantially increased volume. In Pennsylvania, an upper landowner has the right to have surface waters discharged from his land through a natural watercourse or via natural drainage onto lower land. He may make reasonable use of his land even if the quantity or quality of the water is somewhat changed thereby. The supreme court found, however, that water may not be diverted from its natural channel or changed substantially in quantity or quality by the upper landowner to the detriment of the servient owner. Negligence on the part of the upper landowner in collection and discharge of surface water will also give rise to liability. The court stated that the degree of alteration of surface water drainage is an evidentiary problem to be decided at trial. Here the chancellor below had decided that defendant's actions constituted reasonable land use with insignificant detriment to plaintiff. (E Kelly-Fla)
W69-05568

BIBERMAN V FUNKHOUSER (UPPER LANDOWNER'S RIGHT TO HAVE SURFACE WATER DRAIN UPON LOWER LANDOWNER).
58 A 2d 668-672 (Md 1948).

Descriptors: *Maryland, *Riddance (Legal aspects), *Surface runoff, *Natural flow, Surface waters, Judicial decisions, Water law, Grading, Ditches, Land, Surface drainage, Legal aspects, Drainage water, Topography, Ditches.
Identifiers: Artificial change of elevation, Reversal of flow, Injunctions (Mandatory), Dominant estate, Servient estate.

Plaintiff sought to enjoin defendant from permitting water on his property to flow over and upon complainant's lands. Prior to any artificial changes of elevation, defendant's property was the upper and dominant estate. After plaintiff filled in his property, the natural flow of water was reversed, it was made to flow from plaintiff's to defendant's property. Subsequently, defendant graded his lots so as to again reverse the flow to its original course, with the exception of a few small erosion ditches. It was from the consequences of this latter reversal that plaintiff sought relief. Injunctive relief was denied. The court based its decision on the rule that upper landowners are entitled to have surface water flow naturally over the land of the lower landowner. The direction of the original natural flow determines the dominant and servient estates, regardless of subsequent regradings which reverse the levels of the properties. Similarly, trivial changes caused by regrading will not give rise to an action by the lower landowner; the above doctrine will control. The defendant was, however, required to close the ditches through which water flowed as a result of defendant's grading. (Holt-Fla)
W69-05570

TANEY COUNTY V EMPIRE DIST ELECTRIC CO (FLOOD DAMAGE AND CLAIM SETTLEMENT FOR FUTURE DAMAGES).

235 SW 2d 271-173 (Mo 1951).

Descriptors: *Missouri, *Contracts, *Bridge construction, *Flood damage, Legal aspects, Compensation, Dams, Bridges, Bridge design, Claims, Relative rights, Judicial decisions, Local governments.
Identifiers: *White River, Mandamus.

Appellant county filed for a writ of mandamus to compel respondent electric company to revuild a bridge which had been destroyed by flood. The circuit court denied the writ. Appellant claims respondent's duty arises under a contract entered into between appellant and respondent's predecessor whereby respondent was to construct the bridge in question in accordance with certain specifications. Subsequent to the contract, respondent's predecessor paid $10,600 in satisfaction of all claims which would arise out of construction of a dam under congressional authority. Specifications required that the bridge be of sufficient height to be safe at all levels to which the river might reasonably be expected to rise. Appellant alleged that respondent's duty arose under this clause. The Supreme Court of Missouri held that the specific language took precedence over the general and that, since the bridge was 715 feet high, the requirements of the contract were met. The court further ruled that the $10,600 payment for inundation of roads and 'any other claims arising between the parties' was a complete bar to this action since the requirement of compensation may be fulfilled by judicial order or by an agreement between the parties. (Harris-Fla)
W69-05571

UNITED STATES V KANSAS CITY LIFE INSURANCE CO (FLOODING, UNDERFLOWING).
For primary bibliographic entry see Field 04A.
W69-05572

DILLENBECK V STATE (COMPENSATION FOR PERPETUAL EASEMENT TO FLOOD LAND).

83 NYS 2d 308-318 (Ct Cl 1948).

Descriptors: *New York, *Easements, *Compensation, *Overflow, Eminent domain, Legal aspects, Dams, Reservoir operation, Flood control, Land tenure, Relative rights, Judicial decisions, State governments, Peat.
Identifiers: *Fair market value.

Claimants brought this action for compensation from the state for appropriation of a perpetual easement to flood a parcel of land owned by them. The easement would have facilitated operation of a dam and reservoir (Whitney Point) and was to include the right to enter and remove any structures or obstructions detrimental to its operation. Claimants bought the land for $100 and intended to use it as a peat bog. It was contended that the fair market value of the bog was $40,000 based on projected earnings on peat sales. The state claimed fair market value of $100 based on the purchase price. The Court of Claims held that the easement was so exclusive as to render claimant's estate totally subservient to the state. The court determined claimants were entitled to the fair market value of the land for its highest and best available use. However, the alleged increase in value had to be proved and not based on mere speculation. Fair market value is that sum which a willing purchaser, under no compulsion to buy, will pay and which a willing seller, under no compulsion to sell, will accept. Claimants offered no proof of enhanced value based on actual sales of peat so as to sustain the alleged increase in fair market value above the $100 purchase price. The court found that reasonable compensation in these circumstances was $98. (Harris-Fla)
W69-05573

UNITED STATES V WILLIS (ARBITRARINESS IN LAND CONDEMNATION).

211 F 2d 1-4 (8th Cir 1954).

Descriptors: *Federal government, *Project purposes, *Condemnation, *Reservoir operation, Legal aspects, Dams, Land tenure, Relative rights, Compensation, Judicial decisions, Flooding, Eminent domain, Appeals, United States, Project planning, Project benefits, Federal project policy.
Identifiers: *Contour lines.

The owner of an 80.9 acre tract of land petitioned the United States District Court for an order setting aside a judgment of condemnation. The Corps of Engineers determined that it was necessary to condemn the tract as part of a dam and reservoir project because it extended into the heart of the reservoir and was accessable only on one side through another state. The government felt that if such tract remained in private hands, operation of the reservoir would be jeopardized. The District Court set aside the judgment below, ruling that condemnation of land higher in elevation than the contour line (700 feet above sea level), which would never be inundated, was an arbitrary action. The United States appealed. The Court of Appeals held that it was not legally possible to call the judgement of the Corps of Engineers arbitrary since the tract was relatively small and provided a vantage point for reservoir control. The land was susceptible of being used productively to only a limited extent, and the tract was inaccessible from within the state of Arkansas. The court found that just compensation for this plot was $1800. (Harris-Fla)
W69-05574

AMERICAN CYANAMID CO V COMMONWEALTH (POLLUTION ABATEMENT).
For primary bibliographic entry see Field 05G.
W69-05575

STATE V BOLLENBACK (NAVIGABILITY OF LAKE).

63 NW 2d 278-291 (Minn 1954).

Descriptors: *Minnesota, *Non-navigable waters, *Lakes, *Eminent domain, Public rights, Judicial decisions, Right-of-way, Recreation, Boating, Fishing, Hunting, State governments, Federal government, Relative rights, Riparian rights, Riparian land, Bodies of water, Ownership of beds, Condemnation, Easements, Legal aspects, Navigable waters, Patents.
Identifiers: Swales.

The attorney general attacked issuance of an order denying a new trial in a condemnation proceeding commenced upon the request of the Commissioner of Conservation to acquire an easement over private property to establish a public right of way to a lake owned by defendant. The defendant contended that the alleged statutory requirement did not exist because the lake was not a navigable public body of water. Evidence disclosed that the lake did not permanently connect with any other body of water. Although used for hunting and fishing, the lake was not used for commercial navigation, and there was never any settlement around it. The court held that the lake was not navigable. The title to beds of bodies of water not navigable at the time of Minnesota's admission to statehood, and not previously patented, remained in the United States. Title to these beds pass by subsequent patent to the purchaser of the riparian upland. Travel on a body of water for purposes of hunting and fishing is not commerce and provides no basis for a finding that such waters are navigable under the federal test which requires a useful capacity as a public highway of transportation. (Heckerling-Fla)
W69-05576

OSTLUND V STEARNS COUNTY (ARTIFICIAL ACCUMULATION OF SURFACE WATERS).

22 NW 2d 173-174 (Minn 1946).

Descriptors: *Minnesota, *Surface runoff, *Road design, *Surface drainage, Land drainage, Culverts, Ditches, Riparian land, Legal aspects, Damages, Remedies, Judicial decisions, Eminent domain, Drainage water, Roads, Local governments, Road construction, Obstruction to flow, Rivers, Channel flow.
Identifiers: Injunctions (Prohibitory).

Plaintiffs brought suit to enjoin the county from discharging surface waters on plaintiffs' lands and to recover damages for injury to their estates. Plaintiffs' lands lie between a road and the Mississippi River. The land slopes gradually toward the river. Before any road was built, much of the surface water would evaporate, and the excess would run off into the river. As long as the surface of the road was dirt, there was no real drainage problem; however, when the county rebuilt the road, they made certain changes, including raising the road bed one and one half feet. Because of the changes, surface water could no longer flow over the road. The flow of water was channeled through an inadequate culvert onto plaintiffs' lands causing damage. Evidence showed that the surface water could be disposed of at minimal cost. The court upheld the trial court's damage award and sustained the injunctive order prohibiting the county from discharging the water on plaintiffs' premises. When one party collects surface water by artificial means and casts it upon the premises of another in increased and injurious quantities, he is liable for damages incurred. (Heckerling-Fla)
W69-05577

EARLY V SOUTH CAROLINA PUBLIC SERVICE AUTHORITY (CONSTRUCTION OF DAM AND DIVERSION OF RIVER).
For primary bibliographic entry see Field 04A.
W69-05578

ARINE AIR WAYS, INC V STATE (INTERERENCE WITH NAVIGATION).

04 NYS 2d 964-970 (Ct Cl 1951).

escriptors: *New York, *Navigation, *Barriers, Riparian rights, Right of way, Bridges, Navigable aters, Legal aspects, Judicial decisions, Relative ghts, Public rights, Compensation, Legislation, oats, Ships, Access routes, Construction, Eminent omain.
dentifiers: *Bridge clearance, Standing.

laimant maintained a shipyard on a navigable aterway for service to all types of boats. He rought suit for damages on grounds that defenant impaired his riparian rights by constructing a ermanent highway bridge, the height of which efctively excluded from his shipyard all except oats requiring less than 50 feet clearance. The ourt of claims held that the claim was based on minution of business caused by interference with avigation'. The court distinguished a 'navigation' ght from an 'access' right. The former right is a ublic right, the infringement of which is not acionable by individuals; the latter right is a private parian right the infringement of which gives rise a right of action by private riparian owners. The ourt held that although private riparian rights ould not be taken for public use without just comensation, the bridge in question interferred only ith public navigation. Since this was so, any comensation must be statutory since the legislature n interfere with one public right in advancement f another. The court held that plaintiff had been amaged but not wronged. Plaintiff's claim was ismissed. Harris-Fla)
V69-05579

RANCE V STATE (DAMAGES FOR APROPRIATION OF RIPARIAN RIGHTS BY THE TATE).

28 NYS 2d 479-481 (Ct Cl 1954).

escriptors: *New York, *Easements, *Conemnation, *Right of way, Legal aspects, Riparian ghts, Land tenure, Compensation, Landfills, Emankments, Bridges, Navigation, State governents, Judicial decisions, Public rights, Road contruction, Eminent domain, Lakes, Highways, amages.
dentifiers: *Lake Seneca.

laimants were upland owners with a right of acess to Seneca Lake. They alleged damage caused y the building of a highway over the lake and arallel to the shoreline of their property. Contruction of the highway involved filling the area etween the highway and the shore and elevating he road to a level 50 feet above the water. This onstruction completely cut off access to the lake. he court of claims held that riparian owners are ubservient to the state's power to construct offhore improvements in furtherance of navigation nd commerce--the public good out-weighs the rivate interest. The court reasoned, however, that he road construction was not an exercise of the overeign's reserve power over waterways. The ourt further held that appropriation of riparian ights to facilitate commerce is subject to the tate's obligation to give compensation, unless such ppropriation is in furtherance of navigation imrovement, and that damages equal to the difference in value of the land with easements and ithout easements should be awarded. The court warded $10,000 damages to claimant. (Harris-la)
V69-05580

N RE SITE FOR HUNTS POINT SEWAGE TREATMENT WORKS, BOROUGH OF BRONX, CITY OF NEW YORK (OWNERSHIP OF LAND UNDER WATER).

281 App Div 315, 119 NYS 2d 391-409 (Sup Ct 1953).

Descriptors: *New York, *Ownership of beds, *Boundaries (Property), *High water mark, Navigable waters, Local governments, Judicial decisions, Seashores, Beds under water, Relative rights, Riparian rights, Public lands, Land tenure, Cities, Condemnation, Legal aspects, Rivers, Bays.
Identifiers: Coves.

Appeal was taken from a condemnation proceeding in which it was determined that the City of New York and not the claimant had title to certain lands under water on the shore front of the East River. The land was located beyond the high water mark. The decision depended largely on the construction of various colonial patents of predecessors in title of the claimant and the former Town of Westchester. The City succeeded to the former interests of Westchester. Grants of more recent date by the State of New York affecting the land were also involved. The court discussed the wording of the historical grants in attempting to determine what the word 'sound' was intended to describe and what land was actually conveyed by the grants. The court held that crown patents were to be strictly construed in favor of the crown and against patentees. The fact that appurtenance clauses, which included rivers, creeks, and harbors, used in the grant to Westchester were broader than those in grants to private patentees, which overlapped the grant to Westchester, would not warrant a finding that titles to bays or coves were in the city, as successor of the town, and not in successors of private patentees. (Heckerling-Fla)
W69-05581

MUENCH V PUBLIC SERVICE COMMISSION (PUBLIC RIGHTS IN NAVIGABLE RIVER).

53 NW 2d 514-525 (Wis 1952).

Descriptors: *Wisconsin, *Navigable waters, *Adjudication procedure, *Public rights, Judicial decisions, Remedies, Local governments, Administrative agencies, Public benefits, Dams, Rivers, Hydroelectric power, Recreation, Navigable rivers, State governments, Legislation, Legal aspects, Administrative decisions, Relative rights, Navigation.
Identifiers: Standing, Delegation doctrine.

A certain hydro company filed an application with defendant commission to construct and operate a hydroelectric dam. The Conservation Commission objected to such construction on the ground that it would violate public rights. Defendant issued findings under a statute which gave it power to determine whether the dam would in fact obstruct navigation or violate other public rights. The defendant's findings upheld the company's right to construct the dam. Plaintiff, a private citizen, and the Conservation Commission filed motions for rehearing which were denied. The Circuit court held: (1) that the granting or withholding of a statutory water permit was not subject to judicial review since such action was, in effect, the conference of a 'privilege' by the legislature; and (2) that plaintiff was not a party 'aggrieved' by the defendant's action. The court directed dismissal of the action, concluding that the statute under which defendant made its findings was unconstitutional as an excessive delegation of legislative authority. Further, the court held that plaintiff did have standing since his right to use the navigable stream would be substantially impaired by the construction of the dam. (Heckerling-Fla)
W69-05582

COHASSET WATER CO V TOWN OF COHASSET (CONVEYANCE OF WATER WORKS TO TOWN).

72 NE 2d 3-10 (Mass 1947).

Descriptors: *Massachusetts, *Water works, *Contract administration, *Public utilities, Legislation, Cities, Local governments, Negotiations, Performance, Specifications, Property values, Water supply, Judicial decisions, Legal aspects, Permits.
Identifiers: Declaratory relief.

A water company brought suit in equity seeking a declaratory judgment concerning a town's vote to purchase the franchise and corporate property of the water company pursuant to the company's charter. The court held that, although the vote was effective as an exercise of the town's option to purchase, title would pass only upon execution of the power instruments and payment of a price which would be fixed at the time of the vote, not at the time of the conveyance. The court resolved the question as to how the company was to be operated in the interval between the balloting and the acquisition of title and possession by the town, stating that the company, as vendor under the contract to convey, would remain in possession until conveyance was made and would operate the water works for its own account, not as agent or trustee of the town. While the company retained possession, it would be liable for the exercise of 'good husbandry.' Finally, the court ruled that the town, having decided to exercise its option to purchase, had become contractually bound and could not rescind without the company's consent. (Reed-Fla)
W69-05583

PEOPLE V VILLAGE OF BERKELEY (STATUTORY DUTIES UNDER WATER SUPPLY CONTRACTS).

94 N E 2d 550-554 (Ill App 1950), Aff'd 98 N E 2d 743-746 (Ill 1951).

Descriptors: *Illinois, *Supply contracts, *Water supply, *Administrative agencies, Legislation, Cities, Water resources development, Operation and maintenance, Financing, Pipes, Water distribution (Applied), Water sources, Judicial decisions, Legal aspects, Public utilities.
Identifiers: Mandamus.

Plaintiffs sought a writ of mandamus to compel the duly elected officers of a village to enter into a contract with the Hillside-Berkeley Water Commission to supply water to the villages of Hillside and Berkeley. Subsequently, an amended complaint was filed requesting supplemental relief in the form of a declaratory judgment as to the rights and liabilities of the parties. The court held that where, pursuant to statutory authority, two villages pass reciprocal ordinances providing for joint acquisition and operation of a common source of water supply, and a Water Commission is created to effectuate that purpose, if one village enters into contract with the Commission, for water supply, the other village has a statutory duty to so contract. The defendant village was not allowed to disclaim any right, duty, or obligation in connection with the continued functioning of the Commission. (Katz-Fla)
W69-05584

DICKSON V BOARD OF COMM'RS OF CADDO LEVEE (EXPROPRIATION OF RIPARIAN LAND BY THE STATE).

26 So 2d 474-481 (La 1946).

Descriptors: *Louisiana, *Eminent domain, *Riparian land, *Levees, Judicial decisions, Legal aspects, Remedies, Water law, Rivers, State jurisdiction, Compensation, River regulation, Erosion, Appropriation, Relative rights, Public benefits, Public rights.
Identifiers: *Expropriation, Servitudes.

Plaintiff, a riparian owner, sued to recover for lands allegedly appropriated by a levee district. The construction of a levee resulted in the destruction of plaintiff's land and crops by reason of increased erosion caused by the artificial current created in the river. Plaintiff's claim was based upon the 5th Amendment of the Federal Constitution and upon a similar state provision which required just compensation for the taking of private property. Relief was denied. The court summarized the historical treatment of riparian owners and recognized their duty to provide for levees. The property of a riparian owner is subject to the public's right to construct

a levee. The early land grants reserved to the state the right to enter riparian land and construct levees. The court held that these lands were still subject to the levee servitude. To qualify for any compensation, the landowner would have to comply with the gratuitous provision of Article XVI of the Louisiana Constitution which requires him to plead the assessed value of the property for the preceeding year. Plaintiff failed to comply with this provision. (Holt-Fla)
W69-05585

STATE V GLIDDEN CO (CONSTITUTIONALITY OF WATER POLLUTIONS CONTROL STATUTE).
For primary bibliographic entry see Field 05G.
W69-05586

EAVES V CITY OF OTTUMWA (LIABILITY FOR FLOOD DAMAGE).

38 NW 2d 761-770 (Iowa 1949).

Descriptors: *Iowa, *Diversion structures, *Overflow, *Flood damage, Flood gates, Channels, Hydroelectric plants, Dams, Levees, River regulation, Rivers, Floods, Damages, Remedies, Judicial decisions, Legal aspects, Cities, Local governments, Operation and maintenance.
Identifiers: Res ipsa loquitor, Proximate cause, Des Moines River.

Plaintiffs sought to recover damages for flooding allegedly caused by defendant's negligence. Defendant city controlled a hydroelectric plant and a diversion channel on the Des Moines River. Plaintiffs alleged that defendant's negligent failure to open the flood gates astride the diversion channel caused river water to overflow the channel levees causing damage to plaintiff's property. The jury found for the plaintiffs and defendant appealed. This court reversed, holding that an instruction to the jury that the doctrine of res ipsa loquitor was applicable in this case was erroneous since the city did not have exclusive control of the flood water, one of the instrumentalities causing damage, and since the true cause of the injury was no more accessible to defendant than to plaintiffs. The court observed that the jury could find for the plaintiff if they felt that the alleged negligence was the proximate cause of plaintiffs' damage. The defendant owed a duty of exercising reasonable care in operating its facilities, and this was so regardless of whether the land would have been overflowed in its natural state. (Gabrielson-Fla)
W69-05587

CARLSON V A AND P CORRUGATED BOX CORP (FLOODING CAUSED BY NEGLIGENT MAINTENANCE OF DAM).
For primary bibliographic entry see Field 04A.
W69-05588

IODICE V STATE (DUTIES OF DAM OWNERS).

102 NYS 2d 742-750 (App Div 1951).

Descriptors: *New York, *Overflow, *Flood damage, *Dams, Alteration of flow, Spillways, Floods, Flood control, Rivers, Riparian rights, Reservoirs, Damages, Remedies, Judicial decisions, Legal aspects, Natural flow.

Plaintiffs sought to recover for damages caused by overflow from defendant's dam. Plaintiffs alleged that defendant's employees were negligent in failing to maintain the waters impounded behind the dam at a level suffiently below the spillways so that additional water coming into the reservoir because of excessive rain could be contained. A verdict was entered for the plaintiff, and defendant appealed. This court reversed and dismissed the claim, finding that the dam was authorized for the purpose of creating a storage reservoir and not for flood control. Therefore, no duty existed to minimize or eliminate the flooding of the land below to a greater extent than if the river flowed naturally. A dam owner may permit dam overflow where the volume cast into the channel below does not exceed the volume coming in above the dam. Actually, less water flowed through the spillways than came in above the dam. In effect then defendant's actions reduced the extent of plaintiffs' damages. Since the natural flow of the river was not exceeded through defendant's negligence, the defendant was not liable. (Gabrielson-Fla)
W69-05589

GOLDEN V AMORY (LIABILITY FOR FLOODING).
109 NE 2d 131-133 (Mass 1952).

Descriptors: *Dikes, *Overflow, *Flood damage, *Massachusetts, Floods, Dam failure, Damages, Remedies, Flood protection, Judicial decisions, Legal aspects, Excessive precipitation, Rainfall, Intensity, Legislation, Highways, Rivers, Local governments, Inspection.
Identifiers: Proximate cause, Act of God, Nuisance.

As a result of a hurricane a certain river overflowed damaging the real estate of several plaintiffs. Plaintiffs alleged that defendants' dike on the river constituted a nuisance since it had not been approved or inspected by the county commissioners as required by statute. Plaintiffs also alleged negligence in the maintenance of the dike. The judge directed verdicts for the defendants on the second allegation after a verdict for the plaintiffs. Plaintiffs excepted. The court on appeal held that since the dike was primarily a highway and only incidently a dike, the statute requiring approval and inspection was inapplicable. Furthermore, no causal relationship existed between the alleged violation of statute and the flooding as no negligence was shown in the maintenance of the dike. Since the rains which caused the flooding were totally without precedent in the region and of an intensity beyond anyone's anticipation, the court found them to be clearly an act of God. (Gabrielson-Fla)
W69-05590

BLACK RIVER REGULATING DIST. V ADIRONDACK LEAGUE CLUB (CONDEMNATION PROCEEDINGS).

307 N Y 475, 121 NE 2d 428-434 (1954).

Descriptors: *New York, *Eminent domain, *Reservoir construction, *Riverflow, Judicial decisions, Legislation, Reservoir operations, Flood control, Floods, River regulation, Administrative agencies, State governments, Public health, Safety, Public benefits, Public rights, Condemnation, Legal aspects.
Identifiers: Constitutionality.

The plaintiff initiated a condemnation proceeding to obtain defendant's land for construction of a reservoir. Plaintiff intends to construct reservoirs in order to control streamflow in the interests of public health and safety. Defendant contends that plaintiff is prohibited by statute from bringing condemnation proceedings. The statute in question provides that reservoirs may be constructed only for the purpose of furnishing a municipal water supply. Plaintiff challenged the act as unconstitutional. The court found for the defendant, holding a state administrative agency depends upon the legislature for its powers and authority. Inherent in a grant of legislative power is the plenary power reserved to the legislature to alter or revoke such grant. The statute was an alteration of the power conferred upon the plaintiff and was constitutional. (Stewart-Fla)
W69-05591

TAYLOR V STATE (PRESCRIPTIVE RIGHT TO FLOOD LAND).

302 NY 177, 96 NE 2d 765-770 (1951).

Descriptors: *New York, *New York State Barge Canal, *Flood damage, *Prescriptive rights, Impounded waters, Judicial decisions, Check structures, Floodgates, Diversion structures, Overflow, Dam construction, Floodwater, Water spreading, Rainfall intensity, Lakes, Floods.
Identifiers: Estoppel by judgment.

Plaintiffs brought proceedings against the state to recover damages for flooding of their lands by the waters of a lake which constituted part of the state's barge-canal system. Plaintiffs alleged that the flood damage was caused by the state's wrongful maintenance of a dam which impounded the lake's waters at a level so high that, in times of heavy rainfall, plaintiffs' lands were flooded. The state conceded fault as to the building of the dam at an improper level but asserted that it had, by lapse of time, acquired an easement to maintain the dam at such a height and, incidentally, to flood plaintiffs' properties. The court declared that a prescriptive right to continue the dam at a certain height and to divert the resulting floodwaters onto neighboring lands could only be established by a showing that over an appropriate period there was an uninterrupted user of that claimed right by successive floodings of the lands in question. It was not the height of the dam but the frequency and duration of the floods which determined whether the prescriptive right had been acquired. The court concluded that the evidence sustained a finding that the state was liable to plaintiffs. (Reed-Fla)
W69-05592

NIXON V WELCH (SURFACE DRAINAGE EASEMENTS).
For primary bibliographic entry see Field 04A.
W69-05593

JONES V LUCAS (SURFACE DRAINAGE).
For primary bibliographic entry see Field 04A.
W69-05594

SCHEELER V DEWERD (EASEMENT TO TAKE WELL WATER).

256 Wis, 41 NW 2d 635-637 (1950).

Descriptors: *Wisconsin, *Easements, *Water wells, *Water rights, Judicial decisions, Water supply, Watercourses, Water pumping, Deep-well pumping, Groundwater mining, Pipes, Pumping plants, Water delivery, Piping systems, Legal aspects, Relative rights.
Identifiers: Implied rights, covenants.

Plaintiffs brought suit to restrain interference with their right to take water from a well located on defendant's property. The water was supplied to the plaintiffs through a pressure system which was also located on defendant's property. The plaintiffs had paid their proportionate share for the electric pump and pressure system. Upon purchase of the property, plaintiffs received warranty deeds which recited that each was entitled to obtain a supply of water from the well. Plaintiffs' grantor then conveyed the tract upon which the well was located to the defendant, who had constructive notice of the rights of adjoining land owners. After a disagreement, defendant shut off the plaintiffs' water supply. The court held that the plaintiffs had acquired an easement to draw water. Furthermore, since the grant of an easement impliedly confers upon the grantee those additional rights reasonably necessary for full enjoyment of it, the plaintiffs also had the right to use the pressure system. (Stewart-Fla)
W69-05595

STATE ROADS COMMISSION V BERRY (CONDEMNATION AWARDS).

118 A 2d 649-653 (Md 1955).

Descriptors: *Maryland, *Condemnation value, *Easements, *Dairy industry, Judicial decisions,

Condemnation, Legal aspects, Compensation, Economic impact, Farms, Streams, Stock water, Routing, Diversion.

Plaintiff condemned a portion of defendant's dairy farm for use in construction of an expressway. A stream, which was used by defendant to water his stock, flowed across the tract. Plaintiff condemned about 13 acres of the land and also acquired an easement in more than 1 acre for certain stream route charges and facilities. The area taken by plaintiff included nearly all of the stream bed. A fence was placed around the easement area. Plaintiff appealed the condemnation award. In affirming the award, the court held that the judge's questioning of expert witnesses as to the value of the land taken was not reversible error since no ruling was made on the objection. There was also no error in the exclusion of the testimony of the plaintiff's assistant Right of Way Engineer as to the purpose of the fence around the easement area since the extent of the taking is determined by the petition, plats, and the jury's inquisition, not by the understanding of plaintiff's employees. (Molica-Fla)
W69-05596

TALBOT V KERN (SERVITUDES OF DRAINAGE).
62 So 2d 548-551 (La 1953).

Descriptors: *Louisiana, *Easements, *Surface drainage, *Obstruction to flow, Judicial decisions, Drainage water, Riddance (Legal aspects), Drainage, Canals, Surface runoff, Legal aspects, Repulsion (Legal aspects), Relative rights, Ditches.
Identifiers: Injunctions (Mandatory), Injunctions (Prohibitory), Equitable servitudes, Restrictive covenants, Partition, Necessary parties.

Plaintiffs' tracts of land were separated by land owned by defendant. All these tracts were originally part of a plantation which had been partitioned. The partition agreement granted to the respective owners rights of drainage and passage across adjacent tracts. Plaintiffs sought an injunction to restrain defendant from interfering with their right of passage to their land and to compel defendant to remove from cross ditches on his tract certain dams which prevented proper drainage of plaintiffs' lands. The court issued the requested injunction. The other owners of the partitioned plantation were not necessary parties to the suit because the rights granted in the partition agreement were independent. The servitudes created by the act of partition were real servitudes, and, because of continual usage, they were not extinguished by non-use for the prescriptive period. (Molica-Fla)
W69-05597

BROWN V BLANKENSHIP (SUBSERVIENT DRAINAGE).

228 So 2d 496-498 (La 1946).

Descriptors: *Louisiana, *Drainage water, *Repulsion (Legal aspects), *Obstruction to flow, Judicial decisions, Surface runoff, Legal aspects, Drainage, Surface drainage, Channels, Culverts, Channel flow, Natural flow.
Identifiers: Injunctions (Mandatory).

Plaintiff's land was adjacent to defendant's land and at a slightly higher elevation. The surface waters from plaintiff's land drained across a natural channel partly on defendant's land. Defendant's predecessor in title kept the natural drain open, but, by reason of defendant's neglect, the drain had become obstructed by an accumulation of vegetation. This condition impeded surface drainage and caused damage to plaintiff's crops. The court entered a decree ordering defendant to remove the obstructions and vegetation. The fact that plaintiff could deepen a different channel to obtain the desired drainage was not so uncontroverted as to require a different decision. (Molica-Fla)
W69-05598

HUTCHESON V SUMRALL (WATER SUPPLY EASEMENT).

72 So 2d 225-229 (Miss 1954).

Descriptors: *Mississippi, *Easements, *Water supply, *Artesian wells, Judicial decisions, Legal aspects, Federal government, Water rights, Adjudication procedure, Preferences (Water rights), Competing uses, Relative rights.
Identifiers: Equitable servitudes, Covenants, Injunctions (Mandatory).

Plaintiffs purchased land and appurtenances from the federal government. These lands were served with water from artesian wells situated on a parcel of land subsequently conveyed to defendant. Defendant cut off the flow of water, and plaintiffs sought an injunction requiring restoration of the flow to its original volume. At the time of their purchase, defendant knew of the existence of the wells but made no inquiry as to their use. The court held that the requested injunction should issue. The term 'appurtenances' in plaintiffs' deed conveyed any easements existing at the time of the grant. Since the wells were situated on defendant's land, defendant had a paramount right to make use of them. But, as long as the supply of water exceeded the bonafide needs of defendant, plaintiffs were entitled to a share of the excess for their bonafide needs. (Molica-Fla)
W69-05599

LEWALLEN V DAVENPORT (DAMAGE FROM BACKING SURFACE RUNOFF).
For primary bibliographic entry see Field 04A.
W69-05600

6F. Nonstructural Alternatives

EAST FORK DUCK CREEK WATERSHED; NOBLE AND WASHINGTON COUNTIES, OHIO.
Soil Conservation Service, Washington, D. C.
For primary bibliographic entry see Field 06B.
W69-05329

07. RESOURCES DATA

7A. Network Design

PROBLEMS OF THE METHODS AND ACCURACY OF HYDROLOGIC OBSERVATIONS (RUSSIAN),
State Hydrological Inst., Leningrad (USSR).
I. F. Karasen, and A. N. Chizhov.
Transl by V. Gabriel. Proc of the State Hydrol Inst, No 150, 1968. 16 p, 2 fig, 1 tab, 18 ref. Trudy Gos Gidrol Inst, No 150, 1968.

Descriptors: *Mathematical studies, *Mathematical models, *Methodology, *Reservoir storage, Discharge (Water), Stage-discharge relations, Water level fluctuations, Discharge coefficients, Slopes, Measurement, Mechanical equipment, Theoretical analysis, Hydroelectric power, Hydrograph analysis.
Identifiers: *Hydraulic observations, USSR.

On the basis of earlier analytical and experimental studies by Troitsky (1935), Brillyum (1960), Pavlov (1964) and others, an analytical analysis is presented of the optimal accuracy of water level measurements necessary for reliable evaluation of reservoir and river parameters. An assumption is made that errors present in water discharge measurements are a function of water level (stage) observations. These errors can be minimized by calculating the maximum water level amplitudes, the excess of mean early level of discharge variations over a zero level, and by taking into consideration the form of daily discharge-stage curves. The criteria for minimizing the errors in stage measurements, using a water surface slope method, were also analyzed. The study shows that (1) the stage-discharge curve can be applied in most cases, (2) measurements recorded at gaging stations should consider the discharge variations form of the stage-discharge curves and the mean annual water stages, (3) water discharged for hydroelectric use should be considered in evaluating reservoir capacity, (4) a hydraulic method using water surface slope, is more suitable at gaging stations characterized by wide discharge variations, and (5) the development of water slope instruments using pressure differences is considered very desirable. (Gabriel-USGS)
W69-05210

SYNTHETIC HYDROGRAPHS; EFFECTS OF NETWORK GEOMETRY,
Thomas J. Watson Research Center, Yorktown Heights, N. Y.
For primary bibliographic entry see Field 02A.
W69-05432

7B. Data Acquisition

TIME-OF-TRAVEL MEASUREMENTS AND OTHER APPLICATIONS OF DYE TRACING,
Geological Survey, Cheyenne, Wyo. Water Resources Division.
James F. Wilson, Jr.
Int Ass Sci Hydrol Pub No 76, Symp on Hydrol Aspects of Util of Water, Bern, Sept 25-Oct 7, 1967, pp 252-265, 1968. 14 p, 8 fig, 15 ref.

Descriptors: *Tracers, *Tracking techniques, *Dye releases, Indicators, Sampling, Streamflow, Groundwater movement, Fluorometry, Dispersion, Pesticide drift, Path of pollutants, Missouri River.
Identifiers: Rhodamine dyes, Travel time, Dye dilution techniques.

Fluorescent dyes of the rhodamine family are popular hydrologic tracers because of the simplicity and sensitivity of fluorometric procedures. The U.S. Geological Survey uses dyes for time-of-travel measurements, dispersion studies, and streamflow measurements. 'Time-of-travel' is a general term used to describe the downstream movement of water or water-borne materials with time. In the largest measurement to date, a single injection of 1800 kg of 40% dye solution was used to measure a 200 km reach of the Mississippi River, at a discharge of 6700 cu m/sec. A 1300 km reach of the Missouri River was measured twice using simultaneous injections of dye in 10 sub-reaches, at discharges of 550 and 1000 cu m/sec. The above examples and several others are described, to illustrate the following: (1) there is no apparent limit to the size or length of stream which may be studied by dye tracing; (2) time of travel observed by tracing often differs significantly from that computed from channel geometry and streamflow data; (3) excellent longitudinal dispersion information is gained by using tracers; (4) neither pools behind low dams nor heavy industrial and municipal contamination have seriously threatened the success of a measurement by dye tracing; and (5) travel time is a function of streamflow, facilitating interpolation and extrapolation of tracing data. The versatility of dye tracing is illustrated by examples of several other applications, including streamflow measurements, estuarine dispersion studies, herbicide tracing, and groundwater studies. (Knapp-USGS)
W69-05228

IMPROVED DYES FOR WATER TRACING,
Geological Survey, Washington, D. C.
James F. Wilson, Jr.
Geol Surv Water-Supply Pap 1892, Selec Tech in Water Resources Invest, 1966-67, pp 5-8, 1968. 4 p, 1 tab.

Descriptors: *Tracers, *Dye releases, *Fluorescence, Fluorometry, Specific gravity, Filters, Analytical techniques.
Identifiers: Dyes, Rhodamine-B, Rhodamine-WT, Fluorescein, Pontacyl Brilliant Pink B.

The dyes available for water tracing are described, their properties tabulated, and their uses and performance discussed. Dye manufacturers are beginning to tailor the properties of certain fluorescent dyes for water-tracing purposes. Various solutions of rhodamine B are now available with specific gravities in the range 1.00 to 1. Rhodamine WT, a new dye, exhibits low sorptive tendency and is proving to be an excellent tracer, especially for discharge measurements. Selection of fluorometer filters appropriate to the particular dye used is a critical factor in instrument sensitivity. (USGS)
W69-05235

NOMOGRAPHS FOR DETERMINING AMOUNT OF RHODAMINE B DYE FOR TIME-OF-TRAVEL STUDIES,
Geological Survey, Washington, D. C.
Bernard Dunn.
Geol Surv Water-Supply Pap 1892, Selec Tech in Water Resources Invest, 1966-67, pp 9-14, 1968. 6 p, 2 fig, 1 ref.

Descriptors: *Tracers, *Dye releases, *Estimating equations, Estimating costs, Fluorometry, Dispersion.
Identifiers: Nomographs, Dye requirements, Rhodamine-B.

Concentrations of dye are measured at a known distance below the point of injection to calculate the time of travel of a stream. The amount of dye required for injection into a stream needs to be computed in order to hold the level of concentration within desired limits and to minimize the cost of dye. Nomographs that permit rapid determination of the amount of dye required have been prepared for two of the formulas commonly used in dye studies. (USGS)
W69-05236

CONSTANT-RATE-INJECTION EQUIPMENT FOR DYE-DILUTION DISCHARGE MEASUREMENTS,
U S Geological Survey, Washington, D. C.
Ernest D. Cobb.
Geol Surv Water-Supply Pap 1892, Selec Tech in Water Resources Invest, 1966-67, pp 15-22, 1968. 8 p, 5 fig.

Descriptors: *Dye releases, *Tracers, *Discharge measurement, *Equipment, Uniform flow, Flowmeters, Pumps, Flow rates.
Identifiers: Constant-rate dye-injection, Flow regulators, Constant-head injection equipment.

The measurement of stream discharge by the constant-rate-injection dye-dilution method requires accurate injection equipment. Several units that use different principles and have different advantages have been developed. Constant flow rates of dye solution can be maintained by (1) a mariotte unit that maintains a constant head on the discharge orifice, (2) a spring-diaphragm unit that has an automatically adjusted spring-diaphragm-valve mechanism, (3) a floating siphon that maintains a fixed head on the orifice, (4) a constant-level reservoir that stores any solution above a given elevation, and (5) a constant-rate pump that uses a uniform power supply. The mariotte tank is easily and cheaply made and is very reliable, the spring-diaphragm unit is more versatile but also more expensive; and the floating siphon, the constant-level reservoir, and the constant-rate pump all have the advantage that additional solution can be added to the supply reservoir without disrupting the flow rate. (USGS)
W69-05237

SELECTION OF DYE-INJECTION AND MEASURING SITES FOR TIME-OF-TRAVEL STUDIES,
Geological Survey, Washington, D. C.
M. R. Collings.
Geol Surv Water-Supply Pap 1892, Selec Tech in Water Resources Invest, 1966-67, pp 23-29, 1968. 7 p, 1 fig, 2 ref.

Descriptors: *Tracers, *Dye releases, *Sites, Water utilization, Tracking techniques, Streamflow, Fluorometry, Estimating.
Identifiers: Time-of-travel studies, Single injection method, Multiple injection method.

Studies using fluorescent dyes for estimating time of travel in streams may be made by either a single-injection method for the entire study reach or a multiple-injection method whereby the study reach is divided into subreaches. The method used is governed by the specific prerequisites of the study, time and personnel limitations, and other factors. The optimum success of a study depends upon proper selection of dye-injection and measuring sites. Site selection should be made after a comprehensive inventory of the study reach. Factors to be evaluated include channel characteristics of the stream, potential loss of dye, municipal demands, tributary inflow, and stream discharge. (USGS)
W69-05238

COMPARISON OF RESULTS USING THREE SAMPLING TECHNIQUES FOR A FLUOMETRIC DYE STUDY IN A STREAM,
Geological Survey, Washington, D. C.
J. D. Stoner.
Geol Surv Water-Supply Pap 1892, Selec Tech in Water Resources Invest, pp 30-33, 1968. 4 p, 1 fig.

Descriptors: *Dye releases, *Tracers, *Sampling, Monitoring, Fluorometry, Reliability, Dispersion, Pumping.
Identifiers: Grab samples, Pumped samples, Stream traveltime.

Three sampling techniques--grab samples and two different pumping systems--were tested concurrently at a single point in a stream. The means and variances computed for the three sampling methods are shifted from the true means and variances by various time increments. Generally, sampling points along a stream in a time-of-travel or dispersion study are far enough apart to make the error shift insignificant, so that results from different sampling methods are directly comparable. However, some studies require that correction factors be applied to the means and variances. (USGS)
W69-05239

DYE-CLOUD PHOTOGRAPHY,
Geological Survey, Washington, D. C.
James F. Wilson, Jr.
Geol Surv Water-Supply Pap 1892, Selec Tech in Water Resources Invest, 1966-67, pp 37-43, 1968. 7 p, 4 fig, 6 ref.

Descriptors: *Dye releases, *Tracers, *Photography, Aerial photography, Films, Monitoring, Filters.
Identifiers: Dye-cloud photography.

For some time after a fluorescent dye is injected into a water body, the dye cloud is visible and may be photographed to supplement surface sampling qualitatively and quantitatively. Both vertical and oblique aerial photographs provide synotpic views of the surface distribution of the dye, which facilitates monitoring the spatial distrubution of the dye over periods of time. Color photographs are useful for exhibition purposes; black-and-white photographs taken with appropriate filters cost less to publish in reports and are best for quantitative analysis by such techniques as photodensitometry. (USGS)
W69-05241

A MICROKIT FOR DISSOLVED OXYGEN DETERMINATION,
Geological Survey, Washington, D. C.
Keith V. Slack.
Geol Surv Water-Supply Pap 1892, Selec Tech in Water Resources Invest, 1966-67, pp 44-51, 1968. 8 p, 3 fig, 4 ref.

Descriptors: *Analytical techniques, *Dissolved oxygen, Test procedures, Chemical analysis, On-site tests, On-site laboratories, Equipment.
Identifiers: Dissolved oxygen analysis.

Methods are described for determining dissolved oxygen in a water sample contained in a 10-ml hypodermic syringe. Precision is better than 0.5 part ppm. The equipment and supplies are standard items that cost less than $15, exclusive of reagents. A 3- by 5-in. card file box will contain all materials needed for up to 50 dissolved oxygen determinations. Reagents for the azide modification of the Winkler method are either drawn into the 10-ml syringe or injected through the tip into the syringe barrel. The sample can be titrated in a small flask or in the 10-ml syringe. (USGS)
W69-05242

FIELD KIT FOR DETERMINING ALKALINITY,
Geological Survey, Washington, D. C.
J. L. Kunkler.
Geol Surv Water-Supply Pap 1892, Selec Tech in Water Resources Invest, 1966-67, pp 52-54, 1968. 3 p, 1 fig, 1 ref.

Descriptors: *Analytical techniques, *Alkalinity, Test procedures, Chemical analysis, On-site tests, On-site laboratories, Bicarbonates, Carbonates, Travertine.
Identifiers: Alkalinity analysis (Field), Titration.

Accurate field determinations of alkalinity are possible with the described field kit because the temperatures of the standard buffer solutions and the samples are maintained within 2 deg C of the temperature of the sampling source. Field determinations of standard solutions indicate that results deviate less than 1% from the correct values. (USGS)
W69-05243

RAPID FIELD FILTRATION OF WATER SAMPLES,
Geological Survey, Washington, D. C.
Charles F. Berkstresser, Jr.
Geol Surv Water-Supply Pap 1892, Selec Tech in Water Resources Invest, 1966-67, pp 55-59, 1968. 5 p, 2 fig, 2 tab, 3 ref.

Descriptors: *Filtration, *Filters, *Sampling, On-site laboratories, Equipment, Nitrogen.

Equipment for the rapid filtration of water samples in the field at the time of collection is described. Water samples should be filtered to reduce chemical change in storage. The equipment described uses bottled nitrogen to drive the sample through a high-pressure filter. (Knapp-USGS)
W69-05244

FIELD MONITORING OF THE QUALITY OF WATER DURING THE DRILLING OF WELLS,
Geological Survey, Washington, D. C.
Jack Rawson.
Geol Surv Water-Supply Pap 1892, Selec Tech in Water Resources Invest, 1966-67, pp 60-66, 1968. 7 p, 1 fig, 2 tab, 3 ref.

Descriptors: *Analytical techniques, *Test procedures, *Chemical analysis, On-site tests, On-site laboratories, Chlorides, Sulfates, Hardness, Monitoring.
Identifiers: Water quality monitoring.

Simple, rapid, and accurate visual methods of analysis for chloride, sulfate, and hardness are described for use in conjunction with field conductivity measurements to provide more detailed and reliable information on chemical composition of well water sampled and tested during drilling. During the drilling of wells, aquifers that yield water of different chemical composition may be penetrated. Fluid-conductivity logging provides an indication of total dissolved solids content of the waters, but does not indicate types and concentrations of individual ions. (Knapp-USGS)

V69-05245

AMPLING APPARATUS TO MINIMIZE AERA-TION OF WATER FOR THE DETERMINATION OF DISSOLVED GASES,
Geological Survey, Washington, D. C.
. F. Joyner.
Geol Surv Water-Supply Pap 1892, Selec Tech in Water Resources Invest, 1966-67, pp 67-68, 1968. p, 1 fig.

Descriptors: *Sampling, *Water analysis, *Chemical analysis, *Aeration, On-site data collections, Equipment.
Identifiers: Water samplers, Non-aerating water sampler, Dissolved gases.

A sampling apparatus for collecting nonaerated water from shallow depths for the determination of dissolved gases can be assembled from materials available in any chemical laboratory. The device can be used in water only 1 in. deep; conventional samplers for the same purpose cannot be used in water less than 18 in. deep. (USGS)
W69-05246

USE OF CARBON DIOXIDE IN BUBBLE GAGES TO PREVENT PRECIPITATION OF CALCIUM CARBONATE,
Geological Survey, Washington, D. C.
Wallace D. Robbins, and Leon S. Hughes.
Geol Surv Water-Supply Pap 1892, Selec Tech in Water Resources Invest, 1966-67, pp 69-71, 1968. p, 1 fig, 2 ref.

Descriptors: *Stream gages, *Operation and maintenance, Equipment, Calcium carbonate, Reliability, Carbon dioxide, Nitrogen.
Identifiers: Bubble gages, Equipment modifications, Carbona dioxide bubble gages, Clogging prevention.

The tube mouth of the gas-purge system of a bubble gage may become blocked over a period of time by precipitation of calcium carbonate when nitrogen gas is bubbled through the tube into water containing high concentrations of calcium and bicarbonate in solution. Carbon dioxide substituted for nitrogen has proved successful in preventing the precipitation of calcium carbonate at the bubble-gage orifice. The described conversion from nitrogen to carbon dioxide is inexpensive, and thereafter, operation and maintenance costs of the bubble gage are reduced substantially. (USGS)
W69-05247

POLYETHYLENE OIL TUBES FOR STILLING WELLS,
Geological Survey, Washington, D. C.
Robert L. Stewart.
Geol Surv Water-Supply Pap 1892, Selec Tech in Water Resources Invest, 1966-67, pp 72-74, 1968. 3 p, 2 fig.

Descriptors: *Stream gages, *Equipment, *Operation and maintenance, Antifreeze, Tubes.
Identifiers: Stream gage oil tubes, Freezing prevention, Polyethylene sheet tubing.

An inexpensive, economical oil tube to be used in stilling wells of gaging stations for freeze prevention may be made of tubular sheet polyethylene suspended from a steel hoop. The tube can be installed and removed without disturbing the gaging station structure and its instruments. Complete instructions for the construction, installation, and operation of the tubes are given. (Knapp-USGS)
W69-05248

WATER-MANOMETER-AIR-LINE ASSEMBLY FOR DETERMINING DEPTH TO WATER IN WELLS,
Geological Survey, Washington, D. C.
O. J. Loeltz.
Geol Surv Water-Supply Pap 1892, Selec Tech in Water Resources Invest 1966-67, pp 75-82, 1968. 8 p, 4 fig, 1 ref.

Descriptors: *Manometers, *Instrumentation, *Water levels, *Water wells, Water level fluctuations, Measurement.
Identifiers: *Pumping tests, Aquifer tests, Airline manometers, Bubble gages.

An air-line and water-column manometer to be used to measure rapidly and accurately the changes of water level during pumping tests is described, and details of its construction and operation are given. An air-line already installed in a well or one temporarily installed for the duration of testing may be used. Measurements are made by purging the submerged end of the air-line of water and reading the manometer column height at purge pressure. In successive readings, the manometer height differences are equal to well water-level differences. (Knapp-USGS)
W69-05249

MINIMUM AND MAXIMUM WATER-LEVEL RECORDING DEVICES,
Geological Survey, Washington, D. C.
T. E. Kelly.
Geol Surv Water-Supply Pap 1892, Selec Tech in Water Resources Invest 1966-67, pp 83-86, 1968. 4 p, 2 fig.

Descriptors: *Instrumentation, *Observation wells, *Water levels, *High water mark, *Low water mark, Measurement, Equipment, Hydrograph.
Identifiers: Recorders, Minimum water levels, Maximum water levels, Crest-stage recording, Periodic observation.

To supplement periodic water-level measurements in observation wells, two inexpensive devices were constructed to determine the minimum and maximum water levels between visits to a well site. The minimum water level is determined by use of a float, and the maximum water-level device is a modification of a crest-stage station and uses a tube with powdered cork. The devices measure to an accuracy of 0.1 foot. (USGS)
W69-05250

SERVOPSYCHROMETER,
Geological Survey, Washington, D. C.
Woodrow L. Yonts, Jr.
Geol Surv Water-Supply Pap 1892, Selec Tech in Water Resources Invest, 1966-67, pp 87-90, 1968. 4 p, 1 fig.

Descriptors: *Instrumentation, *Calibrations, *Hygrometry, Humidity, Thermometers, Measurement, Analytical techniques.
Identifiers: Sling psychrometers, Servopsychrometers, Wet-bulb thermometers.

A description is given for a servopsychrometer for use inside instrument shelters, where sling psychrometers cannot be used, to check the operation of recording hygrothermographs. The instrument consists of the wet and dry bulb thermometers from a sling psychrometer and a battery-powered electric fan to blow air over the bulbs. Reading of the fan psychrometer and the recording hygrothermograph differ by less than 2% when taken in the same shelter. (Knapp-USGS)
W69-05251

RAFT FOR EVAPORATION-MEASUREMENT EQUIPMENT,
Geological Survey, Washington, D. C.
Richard U. Grozier.
Geol Surv Water-Supply Pap 1892, Selec Tech in Water Resources Invest, 1966-67, pp 91-93, 1968. 3 p 2 fig, 1 ref.

Descriptors: *Instrumentation, *Evaporation, Lakes, Anemometers, Operation and maintenance, Reservoirs.
Identifiers: Instrument raft.

Deterioration of steel barrels in rafts used to support equipment for determining evaporation on reservoirs was eliminated by using plastic foam instead of steel barrels for raft buoyancy. Special frames were devised to hold the plastic foam and the frames were fastened together in a design that made the new raft both safe and sturdy. (USGS)
W69-05252

WATER-STAGE AND RAINFALL DUAL RECORDER,
Geological Survey, Washington, D. C.
George F. Smoot, and Thomas J. Buchanan.
Geol Surv Water-Supply Pap, Selec Tech in Water Resources Invest, 1966-67, pp 94-101, 1968. 8 p, 3 fig.

Descriptors: *Stream gages, *Rain gages, *Instrumentation, Floods, Water measurement.
Identifiers: Rain-stage dual recorder, Recorders.

An instrument is described that records both cumulative rainfall and flood stages on streams with small drainage basins to help define flood frequencies. The stilling well and stage-recording mechanism are installed so that 5-, 10-, or 20-ft ranges of a stage above a predetermined gage height can be recorded during 24 hr; more than 24 hr of flood record on one chart may be difficult to read. Record automatically begins after water stage reaches the predetermined height. The rainfall recorder can register any number of inches of rain because of a siphon system attached to the rainfall-measuring reservoir. After 5 inches of rain have fallen, the siphon empties the reservoir and a new recording cycle is begun. Rainfall record is continuous between service visits to an instrument, which may be 6 to 8 weeks apart if no flood occurs. Both cumulative rainfall and water stage are recorded on one polar coordinate chart with the time of day (but not the date) of an event defined. Rainfall is recorded with an accuracy of plus or minus 0.025 in; different stage ranges are recorded with different accuracies of from plus or minus 0.025 ft for a 5-ft range to plus or minus 0.10 ft for a 20-ft range. (USGS)
W69-05253

POLAR COORDINATE CHART READER FOR STAGE-RAINFALL RECORDER,
Geological Survey, Washington, D. C.
V. B. Sauer.
Geol Surv Water-Supply Pap 1892, Selec Tech in Water Resources Invest, 1966-67, pp 102-108, 1968. 7 p, 5 fig.

Descriptors: *Instrumentation, Rain gages, Stream gages, Water measurement, Hydrograph, Charts.
Identifiers: Polar coordinate chart reader, Recorders, Stage recorders, Rainfall recorders.

The river-stage and rainfall dual recorder makes graphs on a polar coordinate chart that may be difficult and time consuming to read if done by inspection or with scales. The polar coordinate chart reader determines the coordinates of any point on the chart simply, accurately, and consistently. The chart reader consists of a time mechanism and a stage mechanism arranged so that simultaneous readings of time and stage (or cumulative rainfall) can be obtained with one setting of a stylus. Time intervals read can be as small as 10 min, and they can be estimated to 5 min. Stage can be read to 0.01 ft and rainfall to 0.01 in. However, the accuracy of such readings depends on the accuracy of the original chart. (USGS)
W69-05254

CORRECTING RIVER VELOCITIES MEASURED FROM AN UNANCHORED SHIP,
Geological Survey, Washington, D. C.
Luther C. Davis, Jr.
Geol Surv Water-Supply Pap 1892, Selec Tech in Water Resources Invest, 1966-67, pp 109-113, 1968. 5 p, 4 fig.

Descriptors: *Velocity, *Streamflow, *Rivers, *Drifting (Aquatic), *Ships, Stream gages, Measurement, Current meter.

Identifiers: Amazon River, Stream velocity measurements, Drift rate (Ships).

The problem of correcting observed Amazon River velocities that were measured from a nonstationary ship was solved by measuring the distance the unanchored vessel drifted during the 40- and 50-second velocity measurement period. By applying the rate of drift, in feet per second, to the observed velocity reading obtained by current meter, a corrected river-velocity reading was computed. (USGS)
W69-05255

PATTERNS OF BACKWATER AND DISCHARGE ON SMALL ICE-AFFECTED STREAMS,
Geological Survey, Washington, D. C.
R. Elton Cook, and Edwin E. Cerny.
Geol Surv Water-Supply Pap 1892, Selec Tech in Water Resources Invest, 1966-67, pp 114-125, 1968. 12 p, 9 fig.

Descriptors: *Stream gages, *Stage-discharge relations, *Ice, Backwater, Storage, Hydrographs, Discharge (Water).
Identifiers: Stream gaging, Ice effects, Ice storage.

A temporary stream-gaging station was built on an ice-free reach to determine the winter discharge patterns on an ice-affected stream in northern New Mexico. Records from a nearby ice-affected gaging station were compared to records of the temporary station to determine the local daily backwater pattern. The methods used in the study can be applied to improve winter discharge records and the interpretation of winter records of gage height on ice-affected streams. (USGS)
W69-05256

VARIABLE-SPEED POWER EQUIPMENT FOR DEPTH-INTEGRATION SEDIMENT SAMPLING,
Geological Survey, Washington, D. C.
Clarence T. Welborn, and John V. Skinner.
Geol Surv Water-Supply Pap 1892, Selec Tech in Water Resources Invest, 1966-67, pp 126-137, 1968. 12 p, 4 fig, 1 tab.

Descriptors: *Sampling, *Sediments, *Equipment, *Electric motors, Hoisting machinery, Measurement, Instrumentation.
Identifiers: Integrating sediment samplers, Variable speed electric motors, Series-wound motors, Shunt-wound motors.

Power equipment developed for use with sediment samplers used by the U. S. Geological Survey is described. The power units used in collecting depth-integrated suspended-sediment samples must be capable of lowering and raising a sediment sampler at a constant speed and must operate over a range of speeds. Two different power units were built and tested in an attempt to develop an efficient method of controlling transit rates. Power equipment with a series-wound motor was developed by the U. S. Geological Survey and equipment with a shunt-wound motor was developed by the Federal Inter-Agency Sedimentation Project. Both units proved successful. They differ primarily in the type of motor used and in the general method of motor-speed control. A comparison of the series-wound and the shunt-wound power units reveals that the 2 units differ with respect to complexity, efficiency, maintenance, degree of control, and initial cost. The shunt-wound unit affords a greater degree of control and efficiency but at the expense of greater complexity, cost and maintenance. The series-wound unit, because of the smaller number of parts, has a lower initial cost, is more rugged, and requires less maintenance. (USGS)
W69-05257

ELECTRIC CONTROL SYSTEM FOR DUAL OPERATION OF CURRENT METER AND SUSPENDED-SEDIMENT SAMPLER,
Geological Survey, Washington, D. C.
Herbert H. Stevens, Jr., and Robert E. Sommer, Jr.

Geol Surv Water-Supply Pap 1892, Selec Tech in Water Resources Invest, 1966-67, pp 138-141, 1968. 4 p, 2 fig, 1 ref.

Descriptors: *Control systems, *Current meters, *Sampling, Suspended load, Electrical equipment, Monitoring, Velocity.
Identifiers: Suspended-sediment samplers, Diode signal-selectors.

An electric control system for monitoring a current meter and operating a U. S. P-61 suspended sediment sampler on the same 2-conductor cable is described. The system uses diodes to select and send the proper electrical signal to each device, and reduces the time required for observing velocity and sediment concentration on major streams. (Knapp-USGS)
W69-05258

CHARACTERISTICS OF LOGARITHMIC RATING CURVES,
Geological Survey, Washington, D. C.
S. E. Rantz.
Geol Surv Water-Supply Pap 1892, Selec Tech in Water Resources Invest, 1966-67, pp 142-152, 1968. 11 p, 4 fig, 1 tab, 1 ref.

Descriptors: *Stage-discharge relations, Channels, Channel morphology, Discharge coefficients, Back-water, Cross-sections, Equations.
Identifiers: *Rating curves, Logarithmic rating curves, Stage-discharge controls.

An understanding of the shapes of logarithmic rating curves is requisite for analyzing the stage-discharge relation of a stream. The principles that govern the shapes of rating curves are demonstrated. As a general rule, linear logarithmic rating curves for section control have slopes greater than 2; linear logarithmic curves for channel control have slopes less than 2. (USGS)
W69-05259

INTERPRETATION OF FLOOD-FREQUENCY DATA,
Geological Survey, Washington, D. C.
J. R. Crippen, and S. E. Rantz.
Geol Surv Water-Supply Pap 1892, Selec Tech in Water Resources Invest, 1966-67, pp 153-157, 1968. 5 p, 2 fig, 3 ref.

Descriptors: *Floods, *Flood forecasting, Probability, Frequency analysis, Equations, Statistical methods.
Identifiers: Flood frequencies, Flood-frequency curves.

The conventional flood-frequency curve is an excellent tool for studying the economics of planned flood-control measures, but the curve presents an incomplete picture of flood risk. That is, the flood-frequency curve shows the probability of an annual peak discharge being exceeded in any one year, but does not show the probability for a sequence of years. A family of curves is presented that overcomes the deficiency. These curves have universal use in studies of flood risk because they are based on fundamental probability principles and are independent of both the flood data and the statistical distribution represented by the conventional flood-frequency curve. (USGS)
W69-05260

AN OUTLINE OF GEOPHYSICAL LOGGING METHODS AND THEIR USES IN HYDROLOGIC STUDIES,
Geological Survey, Washington, D. C.
A. I. Johnson.
Geol Surv Water-Supply Pap 1892, Selec Tech in Water Resources Invest, 1966-67, pp 158-164, 1968. 7 p, 1 tab, 12 ref.

Descriptors: *Borehole geophysics, *Logging (Recording), Electrical well logging, Radioactive well logging, Radioactivity, Resistivity, Temperature, Aquifers.
Identifiers: Geophysical well logging, Resistivity logging, Sonic logging, SP logging, Gamma-ray logging, Caliper logging, Magnetic logging.

Information on the depth, thickness, extent, and structure of an aquifer may be obtained for use of the hydrologist by judicious choice of the proper geophysical logging methods. To assist in making this choice, the various methods of borehole logging, the uses that may be made of each log, and the recommended borehole conditions are summarized. However, proper use of borehole logs requires some knowledge of the geology of the area and considerable experience in log interpretation. (USGS)
W69-05261

ISOPIESTIC TECHNIQUE FOR MEASURING LEAF WATER POTENTIALS WITH A THERMOCOUPLE PSYCHROMETER,
Duke Univ., Durham, N. C. Dept. of Botany.
For primary bibliographic entry see Field 02I.
W69-05286

AN ACCURATE SMALL ORIFICE RAIN GAGE,
Volcani Inst. of Agricultural Research, Bet Dagan (Israel); and Israel Meteorological Service, Bet Dagan.
J. D. Kalma, J. Lomas, M. Thaller, and Y. Shashoua.
Water Resources Res, Vol 5, No 1, pp 300-305, Feb 1969. 6 p, 3 fig, 1 tab, 11 ref.

Descriptors: *Rain gages, *Instrumentation, Precipitation gages, Research and development, Gaging stations, Rain, Rainfall, Measurement, Water measurement.
Identifiers: Small orifice rain gage, Victor rain gages.

An accurate, inexpensive, small-orifice rain gage (modified Victor-rain gage) with an orifice diameter of 29.2 mm was developed for use in rainfall networks and in agrometeorological and hydrological studies. It has a large capacity and can be installed and read easily. Comparison with standard rain gages showed good agreement under various conditions of exposure and with different observation techniques. Small amounts of rainfall are likely to be overestimated, owing to a film of water adhering to the glass water container of the gage, whereas hail tends to be underestimated. If the gage is intended for storage, the funnel tube has to reach nearly to the bottom of the inner vessel. (Knapp-USGS)
W69-05404

EVALUATION OF SOME GEOPHYSICAL TECHNIQUES APPLIED TO THE ENVIRONMENT OF A MAUI WELL,
Hawaii Inst. of Geophysics, Honolulu.
For primary bibliographic entry see Field 02F.
W69-05418

7C. Evaluation, Processing and Publication

WRITING A WATER QUALITY REPORT,
Federal Water Pollution Control Administration, Cincinnati, Ohio. Biological and Chemical Section.
For primary bibliographic entry see Field 10.
W69-05212

OMPUTERIZED SYSTEM FOR WYOMING URFACE WATER RECORDS,
Vyoming Univ., Laramie. Water Resources esearch Inst.
or primary bibliographic entry see Field 02E.
/69-05326

HE WEATHER BUREAU AND WATER ANAGEMENT.
Veather Bureau, Silver Spring, Md.

SSA Report PI 680010, 1968. 16 p, 3 fig.

escriptors: Hydrologic cycle, *Hydrology, oods, Probable maximum precipitation, River gulation, Rivers, *Streamflow forecasting, Warn-g systems, Water management, Flood control, Vater conservation, Water demand, Water sources, Water supply, Water pollution, Water uality, Water utilization, River forecasting, Flood forecasting, River flow.

addition to protecting life and property in time flood, the hydrologic services of the Weather ureau also help conserve the Nation's vital water sources. This brochure describes the functions at are performed by the Weather Bureau's Office Hydrology. Areas described range from the mea-rement and collection of river and rainfall data to recast preparation and dissemination.
/69-05336

REPARATION OF CO-ORDINATED RECIPITATION, RUNOFF AND EVAPORA-ION MAPS,
Vorld Meteorological Organization, Geneva (Switzerland).
or primary bibliographic entry see Field 02A.
/69-05337

REDICTION OF SEDIMENT PROFILES IN PEN CHANNEL FLOW BY TURBULENT DIF-USION THEORY,
entucky Univ., Lexington; and Texas A and M Jniv., College Station. Water Resources Inst.
or primary bibliographic entry see Field 02J.
/69-05403

COMPUTER METHODS FOR TRANSIENT ANALYSIS OF WATER-TABLE AQUIFERS,
California Univ., Davis; and Ohio State Univ., Columbus.
George S. Taylor, and James N. Luthin.
Water Resources Res, Vol 5, No 1, pp 144-152, Feb 1969. 9 p, 4 fig, 11 ref. OWR Project W-109.

Descriptors: *Drawdown, *Mathematical models, Digital computers, Groundwater movement, Satu-ated flow, Unsaturated flow, Water level fluctua-ions, Theis equation, Thiems equation, Dupuit-Forchheimer theory.
Identifiers: Pumping tests, Aquifer tests, Draw-down analysis.

Computer methods for calculating drawdown in nconfined aquifers are discussed. Solutions for the aturated and unsaturated flow of water to wells nay be obtained simultaneously. The method olves the basic flow equations with given boundary conditions, taking into account the properties of he unsaturated zone and the contribution of verti-al flow. The basic equations are listed and ex-pressed in cylindrical coordinates. The steps to be ised in computer solution by numerical analysis are listed and discussed. (Knapp-USGS)
W69-05435

ANALYZING STEADY-STATE FLOW IN AN INCLINED SOIL SLAB WITH AN ELECTRIC ANALOG,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
For primary bibliographic entry see Field 02G.
W69-05440

COMPUTER EXPERIMENTS WITH FRACTIONAL GAUSSIAN NOISES, PARTS 1, 2, AND 3,
Thomas J. Watson Research Center, Yorktown Heights, N. Y.
Benoit B. Mandelbrot, and James R. Wallis.
Water Resources Res, Vol 5, No 1, pp 228-267, Feb 1969. Total 39 p, 22 fig, 1 tab, 20 ref.

Descriptors: *Mathematical models, *Probability, Hydrologic data, Simulation analysis, Synthetic hydrology, Statistical models, Stochastic processes, Mathematical studies.
Identifiers: Gaussian noise.

Fractional Gaussian noises are a family of random processes such that the interdependence between values of the process at instants of time very distant from each other is small but nonnegligible. It is shown by mathematical analysis that such interdependence has precisely the intensity required for a good mathematical model of long run hydrological and geophysical records. The analysis is illustrated, extended, and made practically usable with the help of computer simulations. The shape of the sample functions and the relations between past and future averages are stressed. (Knapp-USGS)
W69-05453

FREQUENCY CURVES FOR ANNUAL FLOOD SERIES WITH SOME ZERO EVENTS OR INCOMPLETE DATA,
Geological Survey, Washington, D. C.
M. E. Jennings, and M. A. Benson.
Water Resources Res, Vol 5, No 1, pp 276-280, Feb 1969. 5 p, 4 fig, 4 tab, 4 ref.

Descriptors: *Statistical models, *Flood forecasting, *Probability, Hydrograph analysis, Duration curves, Non-perennial streams, Streamflow forecasting.
Identifiers: Flood frequencies, Log-Pearson distributions, Curve fitting.

In fitting a theoretical frequency distribution to a set of data, a problem arises if the series contains a number of zero values, as may occur in annual flood peak data for small, arid-region streams. The problem is twofold: first, commonly used distributions do not fit such a set of data; second, if a logarithmic transformation of the data is being used, logarithms of zero flows are not usable in a computation. To overcome the difficulties, a theorem of conditional probability is used. The probability of occurrence of a nonzero peak is combined with the conditional probability of exceeding a given flood magnitude, given that a nonzero peak has occurred. The method has been found useful also for fitting flood series in which information of peak annual floods below a specific stage is lacking. (Knapp-USGS)
W69-05455

A CONTINUOUS SIZE SPECTRUM FOR PARTICULATE MATTER IN THE SEA,
Fisheries Research Board, Nanaimo (British Columbia). Pacific Oceanographic Group.
R. W. Sheldon, and T. R. Parsons.
J Fish Res Board Can, Vol 24, No 5, pp 909-915, 1967. 5 fig, 12 ref.

Descriptors: *Particle size, *Seston, *Biomass, Carbon, Copepods, Correlation analysis, Diatoms, Estimating equations, Nannoplankton, Nitrogen, Oceanography, Phytoplankton, Plankton, Productivity, Zooplankton, Analytical techniques.
Identifiers: *Particulate matter, *Coulter Counter, Macroplankton, Microplankton, Saanich Inlet, British Columbia, Chaetoceros socialis, Dhaetoceros debilis, Pseudocalanus minutus, Skelotonema costatum.

A plot of total particle volume versus logarithm of particle diameter seems an informative method for presenting size spectra of particulate matter in seawater and is suited to classical divisions of nanno-, micro-, and macro-plankton. In a typical example, delineation of spectrum of sizes from 3 microns to 1 millimeter for particulate matter of single sample drawn from Saanich Inlet, British Columbia, June 1966, discriminated three peaks due to mixed populations of diatoms Chaetoceros socialis and C debilis, to copepod eggs, and to copepod Pseudocalanus minutus. Authors could realistically determine total biomass of irregularly shaped particles, such as phytoplankton chains, using a Coulter Counter. Particle volume measurements agreed well with estimates based upon determination of particle diameter. Where P = particle concentration in ppm by volume estimated with Coulter Counter, C = particulate carbon in ppm by weight, and N = particulate nitrogen in ppm weight, plots of P versus C and N were well described by linear relationships, P = 19C - 3.56, with correlation coefficient of 0.88; and P = 107N - 1.4, with correlation coefficient of 0.52. Correlation coefficients are significant, with probability due to chance less than 0.01. Intercepts of such plots estimate particulate matter not measured by Coulter Counter. (Eichhorn-Wis)
W69-05529

08. ENGINEERING WORKS

8A. Structures

KOYNA EARTHQUAKE OF DECEMBER 11, 1967,
For primary bibliographic entry see Field 08E.
W69-05419

8B. Hydraulics

UNSTEADY FLOW PARAMETERS IN HYDRAULIC DESIGN,
Kansas Univ., Lawrence.
Yun-Sheng Yu, and Mack H. Gray, III.
Contrib No 25, Kans Water Resources Res Inst Proj Completion Rep, Aug 1968. 38 p, 10 fig, 4 tab, 12 ref. OWRR Project A-017-KAN.

Descriptors: *Unsteady flow, *Closed conduit flow, *Pipe flow, Hydraulic transients, Surges, Valves, Fluid mechanics, Hydraulics, Kinetics, Velocity, Hydraulic engineering.
Identifiers: Reservoir-pipe flow systems, Inertial effects.

An experimental and theoretical study was made of the unsteady flow in a reservoir-conduit system caused by the sudden opening of a valve at the end of the conduit. A one-dimensional model which includes resistance and inertial effects is developed to determine the instantaneous average displacement, velocity, and acceleration of fluid in the conduit and the instaneous water depth in the reservoir. The calculations were checked by experiments using a circular reservoir with horizontal circular-section pipes of various diameters with and without streamlined inlets. The dimensionless initial acceleration in linearly related to dimensionless initial water depth for reservoir diameter to pipe diameter ratios (B/D) larger than about 15, and the lumped inertial effects of pipe and reservoir are constant. At smaller B/D, predicted initial accelerations are much higher than actual values if the effects of reservoir inertia are neglected. Reservoir-conduit systems in actual use, however, generally have B/D larger than 90 and the inertial effects of the reservoir are negligible. (Knapp-USGS)
W69-05408

8C. Hydraulic Machinery

PROBLEMS OF THE METHODS AND ACCURACY OF HYDROLOGIC OBSERVATIONS (RUSSIAN),
State Hydrological Inst., Leningrad (USSR).
For primary bibliographic entry see Field 07A.
W69-05210

8D. Soil Mechanics

HYDROLOGY OF A SLIDE-PRONE GLACIAL TILL SOIL IN SOUTHEAST ALASKA,
Forest Service (USDA) Juneau, Alaska. Pacific Northwest Forest and Range Experiment Station.
For primary bibliographic entry see Field 02G.
W69-05406

8E. Rock Mechanics and Geology

KOYNA EARTHQUAKE OF DECEMBER 11, 1967,
K. L. Rao, S. Bhagavantam, D. N. Wadia, M. S. Krishnan, and N. G. K. Murthi.
J Indian Geophys Union, Vol 5, No 1, Jan 1968. 52 p, 10 fig.

Descriptors: *Earthquakes, Hydrologic aspects, Dams, Faults (Geology), Land subsidence, Seismology, Earthquake engineering.
Identifiers: Koyna (India).

The earthquake at Koyna, India, on December 11, 1967, occurred in an area which had no previous recorded seismic activity. Because the epicenter was under the newly filled Koyna dam and reservoir, the possibility of a causal relation was investigated. Because small shocks were felt early in the filling of the reservoir, 2 seismographs, 2 accelerographs, and 2 tiltgraphs were installed in the dam, and an array of seismographs 20-40 miles from the dam. Bores near the dam revealed no major near-surface faults in the nearly horizontal Deccan basalts and volcanic rocks of the area. The early tremors were mild, shallow, centered upstream, and are thought to be evidence of crustal adjustments caused by filling the reservoir. The major shocks are deeper and stronger. The body of the dam was accelerated at 0.42 g along its axis, 0.39 g across the long axis, and 0.34 g vertically. The epicenter was 30 km deep, just downstream from the dam. Slippage probably occurred along the Malabar fault on India's west coast. It is concluded that the major shocks are of tectonic origin and that major structural design for the Deccan Plateau should take the possibility of future earthquakes of large magnitudes into account. (Knapp-USGS)
W69-05419

09. MANPOWER, GRANTS AND FACILITIES

9D. Grants, Contracts, and Research Act Allotments

FOURTH ANNUAL REPORT OF THE STATE OF WASHINGTON WATER RESEARCH CENTER, 1968.
Washington Univ., Seattle; Washington State Univ., Pullman.
John S. Gladwell.
Wash Water Res Center Report, September 1968. 136 p, 5 fig, 4 tab. OWRR Project A-999-WASH.

Descriptors: Birds, Flow, Freshwater, Bacteria, Water pollution, Control, Ground water geology, Drainage basins, Impoundments, Pollution, Economics, Aquatic environment, Legal aspects.
Identifiers: Waterbirds, Streamflow, Aquatic life, Water treatment, Aquifers, Forestry, Pollutants, Lake, Water.

The following major areas of the Annual Report, State of Washington, are reported. Federally Supported Projects Allotment Grant: Waterfowl, Hydrology, Aquatic Bacteria, Water Quality Control, Hydro-geology, Watersheds, Reservoirs, Water Pollution, Agricultural Economics. Matching Grants Program: Subjects--Pollution, Limnology, Ecology, Water Law. Regionally Supported Projects: (1) Water Resources of Washington (2) Weather Modification. Educational Aspects of the Program: Two Hydrology Seminars, Multi-Resources Development Seminar with Federal Government Officials, Seminar Series on the 'Continental Use of Arctic-Flowing Rivers,'. New Course Offering in the General Field of Water Resources, Students Working on all Center Projects, Names and Support, Publications by Water Research Center Personnel, References.
W69-05322

10. SCIENTIFIC AND TECHNICAL INFORMATION

WRITING A WATER QUALITY REPORT,
Federal Water Pollution Control Administration, Cincinnati, Ohio. Biological and Chemical Section.
K. N. Mackenthun.
J Water Pollut Contr Fed, Vol 41, No 1, pp 82-88, Jan 1969. 7 p, 1 fig, 2 ref.

Descriptors: *Technical writing, *Publications, Editing, Abstracts, Documentation, Reviews, Data collections, Investigations.
Identifiers: Water quality report writing.

Report writing is discussed in terms of content and organization, with special emphasis on the content and difficulties of water quality reports. Concise, interpretive writing and clear graphics help readers to comprehend a report's conclusions and factual information. The use of outlines to organize reports is stressed. A report should be planned and outlined in preliminary form at the time of planning the study, but the outline must be flexible to accommodate unexpected results. The audience of a report determines both style and content; reports for specialists, non-specialists, laymen, or lawyers should have different form and emphasis. Good style and proper use of words are important for clarity. Commonly misused words and phrases and their correct equivalents are listed. Revision and review are necessary to make sure that the report is accurate, readable, directed to the proper audience, and unambiguous. (Knapp-USGS)
W69-05212

DETERMINATION OF ORGANOCHLORINE INSECTICIDES IN SOILS AND WATERS,
Wisconsin Univ., Madison. Dept. of Soils; Agricultural Research Service, Washington, D. C.
For primary bibliographic entry see Field 05A.
W69-05325

DATA SYSTEMS AND INFORMATION RETRIEVAL ADAPTABLE TO WATER RESOURCES,
Department of Agriculture, Washington, D. C.
For primary bibliographic entry see Field 06B.
W69-05490

A DISCUSSION OF DATA SYSTEMS AND INFORMATION RETRIEVAL ADAPTABLE TO WATER RESOURCES,
Pennsylvania State Univ., University Park.
For primary bibliographic entry see Field 06B.
W69-05491

SUBJECT INDEX

ACCESS ROUTES
STATE SQUIRE V CITY OF CLEVELAND (FILL LAND AND HIGHWAY USE AS TO LITTORAL RIGHTS).
W69-05555 04C

ACCIDENTS
PENN CENTRAL CO V BUCKLEY AND CO (BRIDGE COLLISIONS SUIT).
W69-05380 06E

ACCRETION(LEGAL ASPECTS)
ADKISSON V STARR (TITLE TO ACCRETION).
W69-05399 06E

ACID MICROFLORA
THE MICROBIAL FLORA OF ACID MINE WATER AND ITS RELATIONSHIP TO FORMATION AND REMOVAL OF ACID,
W69-05314 05G

ACID MINE WATER
SOURCES OF COAL MINE DRAINAGE POLLUTION, WHEELING CREEK WATERSHED, OHIO.
W69-05202 05B

THE MICROBIAL FLORA OF ACID MINE WATER AND ITS RELATIONSHIP TO FORMATION AND REMOVAL OF ACID,
W69-05314 05G

DEVELOPMENT OF BIOLOGICAL INDICES TO POLLUTION LEVELS IN STREAMS AFFECTED BY ACID MINE DRAINAGE AND OIL FIELD BRINE WASTES,
W69-05407 05A

A LIMNOLOGICAL RECONNAISSANCE OF AN IMPOUNDMENT RECEIVING HEAVY METALS WITH EMPHASIS OF DIATOMS AND FISH,
W69-05465 02H

ACTIVATED ALUMINA
A PILOT PLANT STUDY FOR REMOVAL OF SOLUBLE SILICA FROM ROSWELL, NEW MEXICO WATER. PHASE 1. INITIAL CONSTRUCTION AND OPERATION,
W69-05335 03A

ACTS-OF-GOD
CARLSON V A AND P CORRUGATED BOX CORP (FLOODING CAUSED BY NEGLIGENT MAINTENANCE OF DAM).
W69-05588 04A

ADJUDICATION PROCEDURE
MUENCH V PUBLIC SERVICE COMMISSION (PUBLIC RIGHTS IN NAVIGABLE RIVER).
W69-05582 06E

ADMINISTRATION
ROLE OF STATE GOVERNMENTS IN U. S. WATER MANAGEMENT,
W69-05293 06E

REGIONAL RESEARCH IN WATER IN THE NORTH CENTRAL REGION,
W69-05478 06B

ADMINISTRATIVE AGENCIES
COMPLETION OF THE FAIRFAX COUNTY WATER AUTHORITY ACQUISITION PROGRAM.
W69-05539 03D

AMERICAN CYANAMID CO V COMMONWEALTH (POLLUTION ABATEMENT).
W69-05575 05G

PEOPLE V VILLAGE OF BERKELEY (STATUTORY DUTIES UNDER WATER SUPPLY CONTRACTS).
W69-05584 06E

AERATION
SAMPLING APPARATUS TO MINIMIZE AERATION OF WATER FOR THE DETERMINATION OF DISSOLVED GASES,
W69-05246 07B

AEROBIC TREATMENT
WATER QUALITY CHANGES IN CONFINED HOG-WASTE TREATMENT,
W69-05417 05D

ALABAMA
TENNESSEE VALLEY SAND AND GRAVEL CO V PILLING (LIABILITY FOR SEDIMENT DUMPING WHICH MAKES CREEK BED SHALLOWER, WHICH CAUSES MORE FLOODING).
W69-05386 05G

BOBO V YOUNG (ARTIFICIAL DRAINAGE OF SURFACE WATERS AND NATURAL FLOW).
W69-05551 04A

ALGAL TOXINS MEMBRANE
DEMONSTRATION OF A TOXIN FROM APHANIZOMENON FLOS-AQUAE (L.) RALFS,
W69-05306 05C

ALKALINITY
FIELD KIT FOR DETERMINING ALKALINITY,
W69-05243 07B

ALTERATION OF FLOW
BOAT V VAN VEEN (INTERFERENCE WITH WATER FLOW).
W69-05395 04A

REESE V STATE (DAMAGE TO LAND DUE TO DIVERSION OF STREAM).
W69-05560 04A

BRAY V CITY OF WINTER GARDEN (SURFACE WATERS CAST ON LOWER PROPERTY).
W69-05563 04A

EARLY V SOUTH CAROLINA PUBLIC SERVICE AUTHORITY (CONSTRUCTION OF DAM AND DIVERSION OF RIVER).
W69-05578 04A

ANAEROBIC CONDITIONS
WATER QUALITY IN IMPOUNDMENTS AND MODIFICATIONS FROM DESTRATIFICATION,
W69-05467 02H

ANALOG MODELS
ANALYZING STEADY-STATE FLOW IN AN INCLINED SOIL SLAB WITH AN ELECTRIC ANALOG,
W69-05440 02G

ANALYTICAL TECHNIQUES
A MICROKIT FOR DISSOLVED OXYGEN DETERMINATION,
W69-05242 07B

FIELD KIT FOR DETERMINING ALKALINITY,
W69-05243 07B

FIELD MONITORING OF THE QUALITY OF WATER DURING THE DRILLING OF WELLS,
W69-05245 07B

DETERMINATION OF ORGANOCHLORINE INSECTICIDES IN SOILS AND WATERS,
W69-05325 05A

IDENTIFICATION AND DIFFERENTIATION OF HEAVY RESIDUAL OIL AND ASPHALT POLLUTANTS IN SURFACE WATERS BY COMPARATIVE RATIOS OF INFRARED ABSORBANCES,
W69-05421 05A

USING ANALYTICAL METHODS TO DEVELOP A SURFACE-RUNOFF MODEL,
W69-05431 02A

APPLICATION METHODS
VARIABLE ROW SPACING OF IRRIGATED COTTON AS A MEANS FOR REDUCING PRODUCTION COSTS AND CONSERVING WATER,
W69-05277 03F

DETERMINATION OF ORGANOCHLORINE INSECTICIDES IN SOILS AND WATERS,
W69-05325 05A

SOIL OR FOLIAR FERTILIZATION OF WELL-DRAINED AND FLOODED SLASH PINE,
W69-05332 02G

APPROPRIATION
WATER LAW, POLITICS, AND ECONOMICS OUR COMPLEX WATER LAWS AND WATER USE CUSTOMS,
W69-05296 06E

APPROXIMATION METHOD
RATIONAL DISTRIBUTED LAG FUNCTIONS,
W69-05515 06B

AQUATIC PLANTS
COMMON AQUATIC WEEDS,
W69-05446 02I

AQUEDUCTS
BUDA V STATE (ARTIFICIAL CONTROL OF SURFACE WATERS).
W69-05550 04A

AQUIFERS
IDENTIFICATION OF NONLINEAR PARAMETERS OF GROUND WATER BASINS BY HYBRID COMPUTATION,
W69-05271 02F

MEASUREMENT OF SMALL SURFACE DISPLACEMENTS INDUCED BY FLUID FLOW,
W69-05433 02F

DETERMINATION OF FRESH WATERS IN THE CALCAREOUS MASSIF OF 'COSTA BRAVA', SPAIN (FRENCH),
W69-05474 02F

ARID LANDS
THE ASSESSMENT OF SURFACE RUNOFF FROM RAINFALL DATA FOR AN ARID REGION OF WEST PAKISTAN,
W69-05232 02E

ARIZONA
ASSESSING IMPACTS OF DECLINING WATER QUALITY ON GROSS VALUE OUTPUT OF AGRICULTURE, A CASE STUDY,
W69-05273 03C

WATER MANAGEMENT OF FALL-PLANTED SUGAR BEETS IN SALT RIVER VALLEY OF ARIZONA,
W69-05279 03F

ARKANSAS
COMPREHENSIVE BASIN STUDY ON WHITE RIVER BASIN, ARKANSAS AND MISSOURI.
W69-05201 06B

REYNOLDS METAL CO V BALL (SUIT TO RECOVER DAMAGES FOR ALLEGED DEPOSIT OF SEDIMENT CONTAINING POISONOUS SUBSTANCES).
W69-05385 05C

TURNER V SMITH (RESERVOIR OBSTRUCTING LAND DRAINAGE).
W69-05392 04A

ADKISSON V STARR (TITLE TO ACCRETION).
W69-05399 06E

ARTESIAN WELLS
HUTCHESON V SUMRALL (WATER SUPPLY EASEMENT).
W69-05599 06E

ARTIFICIAL USE
LEIPER V HEYWOOD-HALL CONSTR CO (CLAIM OF ARTIFICIALLY INCREASED DRAINAGE ON PART OF UPPER LANDOWNER).
W69-05568 06E

ASPHALT
IDENTIFICATION AND DIFFERENTIATION OF HEAVY RESIDUAL OIL AND ASPHALT POLLUTANTS IN SURFACE WATERS BY COMPARATIVE RATIOS OF INFRARED ABSORBANCES,
W69-05421 05A

ASSESSMENTS
MEYER V CITY OF OAKLAND (VALIDITY OF SPECIAL ASSESSMENTS TO LAND FOR SEWER IMPROVEMENTS).
W69-05542 06E

AUSTRALIA
TISSUE WATER RELATIONS FOR BRIGALOW AND MULGA,
W69-05281 02I

AUTOCORRELATION
AUTOCORRELATION BETWEEN FIRST DIFFERENCES OF MID-RANGES,
W69-05520 06B

AUTUMN
WATER MANAGEMENT OF FALL-PLANTED SUGAR BEETS IN SALT RIVER VALLEY OF ARIZONA,
W69-05279 03F

BARLEY
EFFECTS OF MOISTURE AND FERTILIZER ON YIELDS OF SPRING WHEAT AND BARLEY,
W69-05263 02I

BARRIERS
UNPROTECTED WELLS.
W69-05367 06E

MARINE AIR WAYS, INC V STATE (INTERFERENCE WITH NAVIGATION).
W69-05579 06E

BEACONS
MOORING WATERCRAFT TO BUOYS OR BEACONS.
W69-05373 06E

BEDS
PUBLIC PARKS - PLAYGROUNDS SALE OF RECLAIMED LANDS ABUTTING PARK LANDS.
W69-05365 06E

BEDS UNDER WATER
RIPARIAN LANDS.
W69-05346 06E

ESTABLISHMENT OF STATE CONTROL OVER SUBMERGED LANDS.
W69-05347 06E

PROTECTION OF THE PALISADES.
W69-05352 06E

CONFIRMATORY LEASES AND GRANTS OF SUBMERGED LAND.
W69-05354 06E

DELINQUENT RIPARIAN LEASES RE-ENTRY BY THE STATE.
W69-05356 06E

REMOVAL OF BUSHES, TREES, AND STUMPS FROM FLOWED AREA.
W69-05368 04A

TRUSTEES OF FREEHOLDERS AND COMMONALTY V MORRISEY (TITLE TO BEDS UNDER TIDAL WATERS).
W69-05388 06E

BIOINDICATORS
DEVELOPMENT OF BIOLOGICAL INDICES TO POLLUTION LEVELS IN STREAMS AFFECTED BY ACID MINE DRAINAGE AND OIL FIELD BRINE WASTES,
W69-05407 05A

BIOMASS
A CONTINUOUS SIZE SPECTRUM FOR PARTICULATE MATTER IN THE SEA,
W69-05529 07C

BLANEY-CRIDDLE FORMULA
EFFECT OF MOISTURE REGIMES AND HARVESTS ON EFFICIENCY OF WATER USE BY TEN FORAGE CROPS,
W69-05268 02I

BOARD OF COMMERCE AND NAVIGATION
GRANTS OF SUBMERGED LANDS TO THE STATE, MUNICIPALITIES, AND OTHER SUBDIVISIONS.
W69-05353 06E

BOATS
TAKING OF WATERCRAFT, AIRCRAFT OR DRAFT ANIMALS INJURING OR CUTTING LOOSE BOOMS, RAFTS, VESSELS OR BOATS CIVIL ACTION FOR DAMAGES.
W69-05372 06E

MOORING WATERCRAFT TO BUOYS OR BEACONS.
W69-05373 06E

BOGS
EVAPORATION FROM BOGS IN THE EUROPEAN TERRITORY OF THE USSR,
W69-05214 02D

BOREHOLD GEOPHYSICS
AN OUTLINE OF GEOPHYSICAL LOGGING METHODS AND THEIR USES IN HYDROLOGIC STUDIES,
W69-05261 07B

BOREHOLE GEOPHYSICS
EVALUATION OF SOME GEOPHYSICAL TECHNIQUES APPLIED TO THE ENVIRONMENT OF A MAUI WELL,
W69-05418 02F

BOUNDARIES
OFFSHORE PROSPECTING AND MINING LAWS OF THE UNITED STATES,
W69-05340 06E

BOUNDARIES(PROPERTY)
WATERS OF WHITE LAKE INC V FRICKE (OWNERSHIP OF LAKE BEDS).
W69-05383 06E

HOLDA V PITTSBURGH FORGINGS CO (LANDFILLS AND OWNERSHIP OF BEDS).
W69-05398 06E

ADKISSON V STARR (TITLE TO ACCRETION).
W69-05399 06E

IN RE SITE FOR HUNTS POINT SEWAGE TREATMENT WORKS, BOROUGH OF BRONX, CITY OF NEW YORK (OWNERSHIP OF LAND UNDER WATER).
W69-05581 06E

BOUNDARY DISPUTES
UNITED STATES V STATE OF LOUISIANA (STATE OWNERSHIP OF SUBMERGED, CONTIGUOUS LANDS).
W69-05540 06E

BRACKISH WATER
A PILOT PLANT STUDY FOR REMOVAL OF SOLUBLE SILICA FROM ROSWELL, NEW MEXICO WATER. PHASE 1. INITIAL CONSTRUCTION AND OPERATION,
W69-05335 03A

WATER SUPPLY IN THE BRACKISH-WATER REGIONS OF SOUTH VIETNAM.
W69-05457 02L

BRANCHING MULTISTAGE SYSTEMS
A COMMENT ON OPTIMIZATION METHODS FOR BRANCHING MULTISTAGE WATER RESOURCE SYSTEMS,
W69-05499 06A

BRANCHING WATER SYSTEMS
OPTIMIZATION METHODS FOR BRANCHING MULTISTAGE WATER RESOURCE SYSTEMS--A REPLY TO A COMMENT BY E. F. BRATER,
W69-05501 06A

BRIDGE CLEARANCE
MARINE AIR WAYS, INC V STATE (INTERFERENCE WITH NAVIGATION).
W69-05579 06E

BRIDGE CONSTRUCTION
TANEY COUNTY V EMPIRE DIST ELECTRIC CO (FLOOD DAMAGE AND CLAIM SETTLEMENT FOR FUTURE DAMAGES).
W69-05571 06E

BRIDGES
MORRIS CANAL AND BANKING COMPANY.
W69-05360 06E

PENN CENTRAL CO V BUCKLEY AND CO (BRIDGE COLLISIONS SUIT).
W69-05380 06E

BRIGALOW
TISSUE WATER RELATIONS FOR BRIGALOW AND MULGA,
W69-05281 02I

BRINES
VARIATION IN THE COMPOSITION OF BRINE FROM THE SYLVANIA FORMATION NEAR MIDLAND, MICHIGAN,
W69-05401 02F

DEVELOPMENT OF BIOLOGICAL INDICES TO POLLUTION LEVELS IN STREAMS AFFECTED BY ACID MINE DRAINAGE AND OIL FIELD BRINE WASTES,
W69-05407 05A

BUOYS
MOORING WATERCRAFT TO BUOYS OR BEACONS.
W69-05373 06E

BY-PASS PIPING
WATER POLLUTION CONTROL USING BY-PASS PIPING,
W69-05503 05G

CALCIUM SULFATE
BASIC STUDIES OF SCALE CONTROL,
W69-05334 03A

CALIBRATIONS
SERVOPSYCHROMETER,
W69-05251 07B

CALIFORNIA
ECONOMIC ALTERNATIVES,
W69-05528 05G

CANALS
DELAWARE AND RARITAN CANAL.

W69-05361 04A

CANONICAL CORRELATION
AN ALTERNATIVE PROOF OF HANNAN'S THEOREM ON CANONICAL CORRELATION AND MULTIPLE EQUATION SYSTEMS,
W69-05511 06D

CAPITAL
CAPITAL FORMATION AND GOVERNMENT CAPITAL POLICY IN DEVELOPING ECONOMIES,
W69-05518 06C

CAPITAL FORMATION
CAPITAL FORMATION AND GOVERNMENT CAPITAL POLICY IN DEVELOPING ECONOMIES,
W69-05518 06C

CARBON DIOXIDE
STOMATAL OPENING IN ISOLATED EPIDERMAL STRIPS OF VICIA FABA. I. RESPONSE TO LIGHT AND TO CO2-FREE AIR,
W69-05278 02I

CELL DIVISION
EFFECTS OF PHOSPHATE CONCENTRATION ON CELL DIVISION RATES AND YIELD OF A TROPICAL OCEANIC DIATOM,
W69-05530 05C

CENTRAL U S
REGIONAL RESEARCH IN WATER IN THE NORTH CENTRAL REGION,
W69-05478 06B

DISCUSSION OF REGIONAL RESEARCH IN THE NORTH CENTRAL REGION,
W69-05479 06B

CES PRODUCTION FUNCTION
INCREASING OR DECREASING RETURNS TO SCALE IN THE CONSTANT ELASTICITY OF SUBSTITUTION PRODUCTION FUNCTION,
W69-05505 06D

CHANNEL IMPROVEMENT
WATERWAYS AND WATER FRONTS.
W69-05364 04A

REESE V STATE (DAMAGE TO LAND DUE TO DIVERSION OF STREAM).
W69-05560 04A

CHANNELS
FLAT CHANNEL TERRACES,
W69-05282 02J

WATER WAVES OVER A RECTANGULAR CHANNEL THROUGH A REEF,
W69-05448 02L

CHAPARRAL
MOISTURE-RETENTION CAPACITY OF LITTER UNDER TWO ARIZONA CHAPARRAL COMMUNITIES,
W69-05267 02G

CHARITY
THE UTILITY OF DISASTERS,
W69-05288 06B

CHECK STRUCTURES
ENGINEERING TECHNIQUES AND PRINCIPLES APPLIED TO SOIL EROSION CONTROL,
W69-05333 04D

DROGMILLER V OLSON (OBSTRUCTION TO NATURAL COURSE OF DRAINAGE).
W69-05547 04A

CHEMICAL ANALYSIS
FIELD MONITORING OF THE QUALITY OF WATER DURING THE DRILLING OF WELLS,
W69-05245 07B

SAMPLING APPARATUS TO MINIMIZE AERATION OF WATER FOR THE DETERMINATION OF DISSOLVED GASES,
W69-05246 07B

CHEMISTRY
DYNAMICS OF PHYSICOCHEMISTRY IN A LARGE RESERVOIR,
W69-05466 02H

CHESTER COUNTY(PENNSYLVANIA)
THE PLAN AND PROGRAM FOR THE BRANDYWINE.
W69-05299 06B

CIRCULAR SERIAL CORRELATION
TESTING FOR SERIAL CORRELATION AFTER LEAST SQUARES REGRESSION,
W69-05289 06B

CITIES
PUBLIC PARKS - PLAYGROUNDS SALE OF RECLAIMED LANDS ABUTTING PARK LANDS.
W69-05365 06E

EL PASO WATER IMPROV DIST NO 1 V CITY OF EL PASO (RIGHT OF REMOVAL UNDER WATER SUPPLY CONTRACT).
W69-05558 06E

CLIMATOLOGY
COMPARATIVE STUDY OF SNOW TYPE HYDROLOGY OF NORTHEASTERN CANADA AND OF PLAINS OF RUSSIA AND SIBERIA,
W69-05225 02E

CLOSED CONDUIT FLOW
UNSTEADY FLOW PARAMETERS IN HYDRAULIC DESIGN,
W69-05408 08B

COAL MINES
SOURCES OF COAL MINE DRAINAGE POLLUTION, WHEELING CREEK WATERSHED, OHIO.
W69-05202 05B

COASTAL ENGINEERING
BEACH FRONTS AND WATERWAYS.
W69-05363 04A

COASTAL MARSHES
WETLANDS (CONTROL AND REGULATION IN MAINE).
W69-05366 06E

COASTLINES
UNITED STATES V STATE OF LOUISIANA (STATE OWNERSHIP OF SUBMERGED, CONTIGUOUS LANDS).
W69-05540 06E

COBB-DOUGLAS PRODUCTION FUNCTION
THE ESTIMATION OF MARGINAL PRODUCT FROM A COBB-DOUGLAS PRODUCTION FUNCTION,
W69-05521 06B

COFFERDAMS
MASSMAN-DRAKE V TOWBOAT M/V HUGH C BLASKE, BARGE CHEM 2 (ACTION FOR DAMAGES CAUSED BY A TOWBOAT CAST ADRIFT BY A HURRICANE).
W69-05341 06E

COLD REGIONS
COMPARATIVE STUDY OF SNOW TYPE HYDROLOGY OF NORTHEASTERN CANADA AND OF PLAINS OF RUSSIA AND SIBERIA,
W69-05225 02E

COLORADO RIVER BASIN
NUCLEAR POWER AND WATER DESALTING PLANTS FOR SOUTHWEST UNITED STATES AND NORTHWEST MEXICO.
W69-05203 03A

COMMERCE AND NAVIGATION BOARD
RIPARIAN LANDS.
W69-05346 06E

SURVEY OPERATIONS AND CONTROLS BY THE BOARD OVER SUBMERGED LANDS.
W69-05350 06E

USAGE OF SUBMERGED LAND LEASE AND GRANT CONDITIONS AND PROCEDURE.
W69-05351 06E

CONFIRMATORY LEASES AND GRANTS OF SUBMERGED LAND.
W69-05354 06E

COMPARATIVE DAMAGES
MASONITE CORPORATION V GUY (FISHKILL EFFECTS OF WATER POLLUTION).
W69-05553 05C

COMPENSATION
TENNESSEE GAS TRANSMISSION CO V GREATER LAFOURCHE PORT COMMISSION (DAMAGE FOR FORCED LOWERING OF PIPELINE ACROSS NAVIGABLE STREAM).
W69-05541 06E

DILLENBECK V STATE (COMPENSATION FOR PERPETUAL EASEMENT TO FLOOD LAND).
W69-05573 06E

COMPUTER MODELS
IDENTIFICATION OF NONLINEAR PARAMETERS OF GROUND WATER BASINS BY HYBRID COMPUTATION,
W69-05271 02F

RAINFALL-RUNOFF MODEL FOR SMALL BASIN FLOOD HYDROGRAPH SIMULATION,
W69-05420 02A

COMPUTER PROGRAMS
COMPUTERIZED SYSTEM FOR WYOMING SURFACE WATER RECORDS,
W69-05326 02E

CONDEMNATION
UNITED STATES V WILLIS (ARBITRARINESS IN LAND CONDEMNATION).
W69-05574 06E

CRANCE V STATE (DAMAGES FOR APPROPRIATION OF RIPARIAN RIGHTS BY THE STATE).
W69-05580 06E

CONDEMNATION VALUE
STATE ROADS COMMISSION V BERRY (CONDEMNATION AWARDS).
W69-05596 06E

CONFINED WATER
WATER RESOURCES LAW IN VIRGINIA (ARTIFICALLY CONFINED WATER).
W69-05537 02H

CONIFEROUS TREES
THE INTERCEPTION-TRANSPIRATION RELATIONSHIP OF WHITE SPRUCE AND WHITE PINE,
W69-05274 02D

CONSERVATION
NAVIGABLE STREAMS, PERMISSION TO BRIDGE OR DAM PUBLIC SERVICE FACILITIES NATURAL RESOURCES.
W69-05564 06E

CONSTITUTIONS
NAVIGABLE STREAMS, PERMISSION TO BRIDGE OR DAM PUBLIC

SERVICE FACILITIES NATURAL RESOURCES.
W69-05564 06E

CONTINENTAL SHELF
OFFSHORE PROSPECTING AND MINING LAWS OF THE UNITED STATES,
W69-05340 06E

CONTOUR LINES
UNITED STATES V WILLIS (ARBITRARINESS IN LAND CONDEMNATION)
W69-05574 06E

CONTRACT ADMINISTRATION
COHASSET WATER CO V TOWN OF COHASSET (CONVEYANCE OF WATER WORKS TO TOWN).
W69-05583 06E

CONTRACTS
EL PASO WATER IMPROV DIST NO 1 V CITY OF EL PASO (RIGHT OF REMOVAL UNDER WATER SUPPLY CONTRACT).
W69-05558 06E

TANEY COUNTY V EMPIRE DIST ELECTRIC CO (FLOOD DAMAGE AND CLAIM SETTLEMENT FOR FUTURE DAMAGES).
W69-05571 06E

CONTROL SYSTEMS
ELECTRIC CONTROL SYSTEM FOR DUAL OPERATION OF CURRENT METER AND SUSPENDED-SEDIMENT SAMPLER,
W69-05258 07B

COORDINATION
DISCUSSION OF REGIONAL RESEARCH IN THE NORTH CENTRAL REGION,
W69-05479 06B

CORN BELT
TILLAGE METHODS TO REDUCE RUNOFF AND EROSION IN THE CORN BELT,
W69-05330 03F

CORRELATION ANALYSIS
TESTING FOR SERIAL CORRELATION AFTER LEAST SQUARES REGRESSION,
W69-05289 06B

COSTA RICA
PORTABLE WATER PURIFIERS FOR COSTA RICA,
W69-05456 05D

COSTS
ECONOMICS AND FINANCING OF IRRIGATION PROJECTS,
W69-05221 06C

ECONOMIC ANALYSIS OF PUBLIC WATER SUPPLY IN THE PISCATAQUA RIVER WATERSHED,
W69-05510 03E

COST-BENEFIT ANALYSIS
THE INTERINDUSTRY FACTOR-CONTEXT MATRIX AN APPLICATION FOR THE ANALYSIS AND PROJECTION OF REGIONAL WATER REQUIREMENTS,
W69-05509 06B

COST-BENEFIT RATIO
EAST FORK DUCK CREEK WATERSHED NOBLE AND WASHINGTON COUNTIES, OHIO.
W69-05329 06B

MEYER V CITY OF OAKLAND (VALIDITY OF SPECIAL ASSESSMENTS TO LAND FOR SEWER IMPROVEMENTS).
W69-05542 06E

COTTON
VARIABLE ROW SPACING OF IRRIGATED COTTON AS A MEANS FOR REDUCING PRODUCTION COSTS AND CONSERVING WATER,
W69-05277 03F

COULTER COUNTER
A CONTINUOUS SIZE SPECTRUM FOR PARTICULATE MATTER IN THE SEA,
W69-05529 07C

CRANBERRIES
JONES V LUCAS (SURFACE DRAINAGE).
W69-05594 04A

CRITERIA
WELFARE ECONOMICS, ECONOMIC GROWTH AND THE CHOICE OF TECHNIQUES,
W69-05500 06B

CROP PRODUCTION
ASSESSING IMPACTS OF DECLINING WATER QUALITY ON GROSS VALUE OUTPUT OF AGRICULTURE, A CASE STUDY,
W69-05273 03C

RUNOFF WATER-SPREADING ON LEVELED CROPLAND,
W69-05275 04A

EFFECT OF EARLY-SUMMER SEEDING OF WINTER WHEAT ON YIELD, SOIL MOISTURE, AND SOIL NITRATE,
W69-05280 03F

RELATIONSHIP OF PALMER DROUGHT VARIABLES TO YIELD OF WINTER WHEAT.
W69-05283 03F

STUDIES ON WATER USE IN PEA (PISUM SATIVUM L.),
W69-05287 03F

SOIL OR FOLIAR FERTILIZATION OF WELL-DRAINED AND FLOODED SLASH PINE,
W69-05332 02G

CROP RESPONSE
EFFECTS OF MOISTURE AND FERTILIZER ON YIELDS OF SPRING WHEAT AND BARLEY,
W69-05263 02I

MEASUREMENT OF DROUGHT RESISTANCE IN CROP PLANTS,
W69-05265 02G

CURRENT METERS
ELECTRIC CONTROL SYSTEM FOR DUAL OPERATION OF CURRENT METER AND SUSPENDED-SEDIMENT SAMPLER,
W69-05258 07B

CURRENTS(WATER)
EQUILIBRIUM FLOW AREAS OF INLETS ON SANDY COASTS,
W69-05447 02L

DAIRY INDUSTRY
STATE ROADS COMMISSION V BERRY (CONDEMNATION AWARDS).
W69-05596 06E

DAM FAILURE
CARLSON V A AND P CORRUGATED BOX CORP (FLOODING CAUSED BY NEGLIGENT MAINTENANCE OF DAM).
W69-05588 04A

DAMAGES
PETERSON V WISCONSIN RIVER POWER CO (PROPERTY ENCROACHMENT BY IMPOUNDED WATERS).
W69-05552 04A

W B RODDENBERY CO INC V CARTER (DAMAGES FOR POLLUTION OF STREAM).
W69-05559 05B

DAMS
REMOVAL OF BUSHES, TREES, AND STUMPS FROM FLOWED AREA.
W69-05368 04A

TOWN OF VIENNA V STATE (PRESCRIPTIVE RIGHTS DOCTRINE AS APPLIED TO PUBLIC PROPERTY).
W69-05549 04A

BOBO V YOUNG (ARTIFICIAL DRAINAGE OF SURFACE WATERS AND NATURAL FLOW).
W69-05551 04A

PETERSON V WISCONSIN RIVER POWER CO (PROPERTY ENCROACHMENT BY IMPOUNDED WATERS).
W69-05552 04A

CORNETT V HEBERT (OBSTRUCTION TO FLOW OF SURFACE WATER).
W69-05562 04A

CARLSON V A AND P CORRUGATED BOX CORP (FLOODING CAUSED BY NEGLIGENT MAINTENANCE OF DAM).
W69-05588 04A

IODICE V STATE (DUTIES OF DAM OWNERS).
W69-05589 06E

DATA COLLECTIONS
FLOODS IN VIRGINIA - MAGNITUDE AND FREQUENCY,
W69-05415 02E

WATER QUALITY INVESTIGATION, PART 1 - BASIC DATA, FORT LOUDOUN RESERVOIR, APRIL 1966 - JUNE 1968,
W69-05416 05A

DATA PROCESSING
COMPUTERIZED SYSTEM FOR WYOMING SURFACE WATER RECORDS,
W69-05326 02E

DATA STORAGE AND RETRIEVAL
COMPUTERIZED SYSTEM FOR WYOMING SURFACE WATER RECORDS,
W69-05326 02E

DATA SYSTEMS AND INFORMATION RETRIEVAL ADAPTABLE TO WATER RESOURCES,
W69-05490 06B

A DISCUSSION OF DATA SYSTEMS AND INFORMATION RETRIEVAL ADAPTABLE TO WATER RESOURCES
W69-05491 06B

DATA SYSTEMS
DATA SYSTEMS AND INFORMATION RETRIEVAL ADAPTABLE TO WATER RESOURCES,
W69-05490 06B

DECREASING RETURNS TO SCALE
INCREASING OR DECREASING RETURNS TO SCALE IN THE CONSTANT ELASTICITY OF SUBSTITUTION PRODUCTION FUNCTION,
W69-05505 06D

DELAWARE
CICONTE V SHOCKLEY (RUNOFF NUISANCE).
W69-05396 04A

DELAWARE ESTUARY
THE LONGITUDINAL DIFFUSION COEFFICIENT IN THE DELAWARE RIVER ESTUARY AS DETERMINED FROM A STEADY-STATE MODEL,
W69-05428 02L

WATER POLLUTION CONTROL USING BY-PASS PIPING,
W69-05503 05G

DELAWARE RIVER BASIN COMPACT
DELAWARE RIVER BASIN COMPACT.
W69-05342 04A

W69-05343 04A

W69-05344 04A

DEMONSTRATION WATERSHEDS
IN DEFENSE OF EXPERIMENTAL WATERSHEDS,
W69-05405 02A

DENITRIFICATION
NITROGEN CYCLE IN SURFACE AND SUBSURFACE WATERS,
W69-05323 05B

DENSITY CURRENTS
DYNAMICS OF PHYSICOCHEMISTRY IN A LARGE RESERVOIR,
W69-05466 02H

DEPOSITION(SEDIMENTS)
COATES V UNITED STATES (TAKING OF PROPERTY FOR PUBLIC PURPOSE WITHOUT JUST COMPENSATION).
W69-05554 04A

DESALINATION
NUCLEAR POWER AND WATER DESALTING PLANTS FOR SOUTHWEST UNITED STATES AND NORTHWEST MEXICO.
W69-05208 03A

BASIC STUDIES OF SCALE CONTROL,
W69-05334 03A

DIATOMS
A LIMNOLOGICAL RECONNAISSANCE OF AN IMPOUNDMENT RECEIVING HEAVY METALS WITH EMPHASIS OF DIATOMS AND FISH,
W69-05465 02H

EFFECTS OF PHOSPHATE CONCENTRATION ON CELL DIVISION RATES AND YIELD OF A TROPICAL OCEANIC DIATOM,
W69-05530 05C

DIFFUSION
THE LONGITUDINAL DIFFUSION COEFFICIENT IN THE DELAWARE RIVER ESTUARY AS DETERMINED FROM A STEADY-STATE MODEL,
W69-05428 02L

HYDRODYNAMIC DISPERSION IN A SATURATED HOMOGENEOUS POROUS MEDIUM AT LOW PECLET NUMBERS AND NONHOMOGENEOUS SOLUTION,
W69-05434 01B

DIGITAL COMPUTERS
COMPUTER METHODS FOR TRANSIENT ANALYSIS OF WATER-TABLE AQUIFERS,
W69-05435 07C

DIKES
DROGMILLER V OLSON (OBSTRUCTION TO NATURAL COURSE OF DRAINAGE).
W69-05547 04A

GOLDEN V AMORY (LIABILITY FOR FLOODING).
W69-05590 06E

DISASTERS
THE UTILITY OF DISASTERS,
W69-05288 06B

PORTABLE WATER PURIFIERS FOR COSTA RICA,
W69-05456 05D

DISCHARGE MEASUREMENT
CONSTANT-RATE-INJECTION EQUIPMENT FOR DYE-DILUTION DISCHARGE MEASUREMENTS,
W69-05237 07B

DISPERSION
HYDRODYNAMIC DISPERSION IN A SATURATED HOMOGENEOUS POROUS MEDIUM AT LOW PECLET NUMBERS AND NONHOMOGENEOUS SOLUTION,
W69-05434 01B

DISSOLVED OXYGEN
A MICROKIT FOR DISSOLVED OXYGEN DETERMINATION,
W69-05242 07B

WATER QUALITY IN IMPOUNDMENTS AND MODIFICATIONS FROM DESTRATIFICATION,
W69-05467 02H

DISTRIBUTED LAG FUNCTIONS
RATIONAL DISTRIBUTED LAG FUNCTIONS,
W69-05515 06B

DISTRIBUTED LAGS
DISTRIBUTED LAGS A SURVEY,
W69-05514 06B

DISTRIBUTION PATTERNS
PREDICTING FIELD DISTRIBUTIONS OF SPRINKLER SYSTEMS,
W69-05285 03F

DITCHES
COUNTY COMMISSIONERS OF BALTIMORE COUNTY V HUNTER (DRAINAGE EASEMENT NUISANCE).
W69-05400 04A

DROGMILLER V OLSON (OBSTRUCTION TO NATURAL COURSE OF DRAINAGE).
W69-05547 04A

NIXON V WELCH (SURFACE DRAINAGE EASEMENTS).
W69-05593 04A

DIURNAL

SEASONAL AND DIURNAL VARIATION IN POCOSIN SHRUB MOISTURE CONTENT,
W69-05331 02I

DIVERSION
MORRIS CANAL AND BANKING COMPANY.
W69-05359 06E

W69-05360 06E

POIRE V SERRA (PROPRIETY OF LAND FILL BY RIPARIAN OWNER).
W69-05381 04A

LAWRENCE V EASTERN AIRLINES (DIVERSION OF NATURAL FLOW).
W69-05546 04A

REESE V STATE (DAMAGE TO LAND DUE TO DIVERSION OF STREAM).
W69-05560 04A

DIVERSION DAMS
EARLY V SOUTH CAROLINA PUBLIC SERVICE AUTHORITY (CONSTRUCTION OF DAM AND DIVERSION OF RIVER).
W69-05578 04A

DIVERSION STRUCTURES
ENDERSON V KELEHAN (UPLAND DRAINAGE OF SURFACE WATERS).
W69-05390 04A

EAVES V CITY OF OTTUMWA (LIABILITY FOR FLOOD DAMAGE).
W69-05587 06E

DOMESTIC ANIMALS
NITROGEN CYCLE IN SURFACE AND SUBSURFACE WATERS,
W69-05323 05B

DOMESTIC WASTES
GREEN V MCCLOUD (ACTION TO ENJOIN SEWAGE FLOW).
W69-05389 05G

DOMESTIC WATER
THE COMPETITION FOR WATER QUALITY DOMESTIC USE,
W69-05527 05G

DRAINAGE
DRAINAGE AND FLOWAGE OF LANDS.
W69-05362 04A

CORNETT V HEBERT (OBSTRUCTION TO FLOW OF SURFACE WATER).
W69-05562 04A

BRAY V CITY OF WINTER GARDEN (SURFACE WATERS CAST ON LOWER PROPERTY).
W69-05563 04A

LEIPER V HEYWOOD-HALL CONSTR CO (CLAIM OF ARTIFICIALLY INCREASED DRAINAGE ON PART OF UPPER LANDOWNER).
W69-05568 06E

DRAINAGE EFFECTS
SOIL OR FOLIAR FERTILIZATION OF WELL-DRAINED AND FLOODED SLASH PINE,
W69-05332 02G

DRAINAGE WATER
DEYO V ATHOL HOUSING AUTHORITY (DAMAGE FROM WATER DISCHARGE).
W69-05556 04C

BROWN V BLANKENSHIP (SUBSERVIENT DRAINAGE).
W69-05598 06E

DRAINS
DESTEFANO V MEGLIO (DAMAGES FOR OBSTRUCTION OF A DRAIN).
W69-05543 06E

DRAWDOWN
COMPUTER METHODS FOR TRANSIENT ANALYSIS OF WATER-TABLE AQUIFERS,
W69-05435 07C

DRIFTING(AQUATIC)
CORRECTING RIVER VELOCITIES MEASURED FROM AN UNANCHORED SHIP,
W69-05255 07B

DROUGHT RESISTANCE
DROUGHT AND PHOSPHORUS AFFECT GROWTH OF ANNUAL FORAGE LEGUMES,
W69-05264 02I

MEASUREMENT OF DROUGHT RESISTANCE IN CROP PLANTS,
W69-05265 02G

TISSUE WATER RELATIONS FOR BRIGALOW AND MULGA,
W69-05281 02I

DROUGHTS
RELATIONSHIP OF PALMER DROUGHT VARIABLES TO YIELD OF WINTER WHEAT,
W69-05283 03F

HYDROLOGIC EFFECTS OF THE 1962-66 DROUGHT ON LONG ISLAND, N. Y.,
W69-05411 02A

DRY FARMING
MEASUREMENT OF DROUGHT RESISTANCE IN CROP PLANTS,
W69-05265 02G

DUAL PRICES
A NOTE ON THE DUAL PRICES OF INTEGER PROGRAMS,

W69-05523 06C

DUNES
SOIL PROBLEMS IN RESEEDING A GREASEWOOD-RABBITBRUSH RANGE SITE,
W69-05269 02G

DURBIN-WATSON STATISTIC
USE OF THE DURBIN-WATSON STATISTIC IN INAPPROPRIATE SITUATIONS,
W69-05516 06D

DYE RELEASES
TIME-OF-TRAVEL MEASUREMENTS AND OTHER APPLICATIONS OF DYE TRACING,
W69-05228 07B

IMPROVED DYES FOR WATER TRACING,
W69-05235 07B

NOMOGRAPHS FOR DETERMINING AMOUNT OF RHODAMINE B DYE FOR TIME-OF-TRAVEL STUDIES,
W69-05236 07B

CONSTANT-RATE-INJECTION EQUIPMENT FOR DYE-DILUTION DISCHARGE MEASUREMENTS,
W69-05237 07B

SELECTION OF DYE-INJECTION AND MEASURING SITES FOR TIME-OF-TRAVEL STUDIES,
W69-05238 07B

COMPARISON OF RESULTS USING THREE SAMPLING TECHNIQUES FOR A FLUOMETRIC DYE STUDY IN A STREAM,
W69-05239 07B

DYE-CLOUD PHOTOGRAPHY,
W69-05241 07B

DYNAMIC PROGRAMMING
A COMMENT ON OPTIMIZATION METHODS FOR BRANCHING MULTISTAGE WATER RESOURCE SYSTEMS,
W69-05499 06A

OPTIMIZATION METHODS FOR BRANCHING MULTISTAGE WATER RESOURCE SYSTEMS--A REPLY TO A COMMENT BY E. F. BRATER,
W69-05501 06A

DYSTROPHY
RESERVOIR EUTROPHICATION AND DYSTROPHICATION FOLLOWING IMPOUNDMENT,
W69-05471 02H

EARLY PLANTING
EFFECT OF EARLY-SUMMER SEEDING OF WINTER WHEAT ON YIELD, SOIL MOISTURE, AND SOIL NITRATE,
W69-05280 03F

EARTHQUAKES
KOYNA EARTHQUAKE OF DECEMBER 11, 1967,
W69-05419 08E

EASEMENTS
THE PLAN AND PROGRAM FOR THE BRANDYWINE.
W69-05299 06B

MORRIS CANAL AND BANKING COMPANY.
W69-05359 06E

DELAWARE AND RARITAN CANAL.
W69-05361 04A

LOCH SHELDRAKE ASSOCIATES V EVANS (RESTRICTIVE CLAUSE ON THE USES OF WATER).
W69-05548 06E

CORNETT V HEBERT (OBSTRUCTION TO FLOW OF SURFACE WATER).
W69-05562 04A

MORRIS V WINTERS (ACTION TO REMOVE AN OBSTRUCTION TO WATER FLOW).
W69-05567 04A

DILLENBECK V STATE (COMPENSATION FOR PERPETUAL EASEMENT TO FLOOD LAND).
W69-05573 06E

CRANCE V STATE (DAMAGES FOR APPROPRIATION OF RIPARIAN RIGHTS BY THE STATE).
W69-05580 06E

NIXON V WELCH (SURFACE DRAINAGE EASEMENTS).
W69-05593 04A

SCHEELER V DEWERD (EASEMENT TO TAKE WELL WATER).
W69-05595 06E

STATE ROADS COMMISSION V BERRY (CONDEMNATION AWARDS).
W69-05596 06E

TALBOT V KERN (SERVITUDES OF DRAINAGE).
W69-05597 06E

HUTCHESON V SUMRALL (WATER SUPPLY EASEMENT).
W69-05599 06E

EAST FORK DUCK CREEK WATERSHED
EAST FORK DUCK CREEK WATERSHED NOBLE AND WASHINGTON COUNTIES, OHIO.
W69-05329 06B

ECONOMIC FEASIBILITY
VARIABLE ROW SPACING OF IRRIGATED COTTON AS A MEANS FOR REDUCING PRODUCTION COSTS AND CONSERVING WATER,
W69-05277 03F

ECONOMIC IMPACT
ASSESSING IMPACTS OF DECLINING WATER QUALITY ON GROSS VALUE OUTPUT OF AGRICULTURE, A CASE STUDY,
W69-05273 03C

BROAD SCOPE OF NAVIGATION'S ECONOMIC IMPACT,
W69-05449 06B

ECONOMIC STABILITY
MONEY, MULTIPLIER ACCELERATOR INTERACTION AND THE BUSINESS CYCLE,
W69-05291 06B

ECONOMIC VARIABLE
THE TYPICAL SPECTRAL SHAPE OF AN ECONOMIC VARIABLE,
W69-05522 06D

ECONOMICS
ECONOMICS AND FINANCING OF IRRIGATION PROJECTS,
W69-05221 06C

WELFARE ECONOMICS, ECONOMIC GROWTH AND THE CHOICE OF TECHNIQUES,
W69-05500 06B

ELECTRIC MOTORS
VARIABLE-SPEED POWER EQUIPMENT FOR DEPTH-INTEGRATION SEDIMENT SAMPLING,
W69-05257 07B

ELECTRICAL RESISTANCE
EVALUATION OF SOME GEOPHYSICAL TECHNIQUES APPLIED TO THE ENVIRONMENT OF A MAUI WELL,
W69-05418 02F

ELECTRICITY
MALICIOUS MISCHIEFS-PUBLIC UTILITIES.
W69-05374 04C

EMINENT DOMAIN
TENNESSEE GAS TRANSMISSION CO V GREATER LAFOURCHE PORT COMMISSION (DAMAGE FOR FORCED LOWERING OF PIPELINE ACROSS NAVIGABLE STREAM).
W69-05541 06E

COATES V UNITED STATES (TAKING OF PROPERTY FOR PUBLIC PURPOSE WITHOUT JUST COMPENSATION).
W69-05554 04A

STATE V BOLLENBACK (NAVIGABILITY OF LAKE).
W69-05576 06E

DICKSON V BOARD OF COMM'RS OF CADDO LEVEE (EXPROPRIATION OF RIPARIAN LAND BY THE STATE).
W69-05585 06E

BLACK RIVER REGULATING DIST. V ADIRONDACK LEAGUE CLUB (CONDEMNATION PROCEEDINGS).
W69-05591 06E

ENCROACHMENT
BEACH FRONTS AND WATERWAYS.
W69-05363 04A

ENERGY BUDGET
SNOW ACCUMULATION AS RELATED TO METEOROLOGICAL, TOPOGRAPHIC, AND FOREST VARIABLES IN CENTRAL SIERRA NEVADA, CALIFORNIA,
W69-05226 02C

ENGINEERING
BUDA V STATE (ARTIFICIAL CONTROL OF SURFACE WATERS).
W69-05550 04A

ENUMERATION
OPTIMIZATION METHODS FOR BRANCHING MULTISTAGE WATER RESOURCE SYSTEMS--A REPLY TO A COMMENT BY E. F. BRATER,
W69-05501 06A

EPIDERMIS
STOMATAL OPENING IN ISOLATED EPIDERMAL STRIPS OF VICIA FABA. I. RESPONSE TO LIGHT AND TO CO2-FREE AIR,
W69-05278 02I

EQUIPMENT
CONSTANT-RATE-INJECTION EQUIPMENT FOR DYE-DILUTION DISCHARGE MEASUREMENTS,
W69-05237 07B

POLYETHYLENE OIL TUBES FOR STILLING WELLS,
W69-05248 07B

VARIABLE-SPEED POWER EQUIPMENT FOR DEPTH-INTEGRATION SEDIMENT SAMPLING,
W69-05257 07B

EROSION
GRANITES, GRUSSES, AND THE SHERMAN EROSION SURFACE, SOUTHERN LARAMIE RANGE, COLORADO-WYOMING,
W69-05211 02J

BEACH FRONTS AND WATERWAYS.
W69-05363 04A

EROSION CONTROL
FLAT CHANNEL TERRACES,
W69-05282 02J

ENGINEERING TECHNIQUES AND PRINCIPLES APPLIED TO SOIL EROSION CONTROL,
W69-05333 04D

WATERWAYS AND WATER FRONTS.
W69-05364 04A

ESSENTIAL NUTRIENTS
NITROGEN CYCLE IN SURFACE AND SUBSURFACE WATERS,
W69-05323 05B

ESTIMATING EQUATIONS
NOMOGRAPHS FOR DETERMINING AMOUNT OF RHODAMINE B DYE FOR TIME-OF-TRAVEL STUDIES,
W69-05236 07B

ESTOPPEL
BOBO V YOUNG (ARTIFICIAL DRAINAGE OF SURFACE WATERS AND NATURAL FLOW).
W69-05551 04A

ESTUARIES
ON THE REPRESENTATION OF THE REYNOLDS STRESS IN A TIDAL ESTUARY,
W69-05213 02L

THE LONGITUDINAL DIFFUSION COEFFICIENT IN THE DELAWARE RIVER ESTUARY AS DETERMINED FROM A STEADY-STATE MODEL,
W69-05428 02L

EUTROPHICATION
BIOLOGICAL ASPECTS OF EUTROPHICATION IN LAKES MENDOTA, CHYSTAL, TROUT AND GREEN,
W69-05324 02H

RESERVOIR MANAGEMENT PROBLEMS CREATED BY INCREASED PHOSPHORUS LEVELS OF SURFACE WATERS,
W69-05470 02H

RESERVOIR EUTROPHICATION AND DYSTROPHICATION FOLLOWING IMPOUNDMENT,
W69-05471 02H

EVAPORATION
EVAPORATION FROM BOGS IN THE EUROPEAN TERRITORY OF THE USSR,
W69-05214 02D

RAFT FOR EVAPORATION-MEASUREMENT EQUIPMENT,
W69-05252 07B

PREPARATION OF CO-ORDINATED PRECIPITATION, RUNOFF AND EVAPORATION MAPS,
W69-05337 02A

EVAPORATION CONTROL
EFFECT OF FATTY ALCOHOL ON CHANGE IN SOIL WATER DURING THE SUMMER FALLOW PERIOD
W69-05284 02G

EVAPOTRANSPIRATION
A METHOD OF DETERMINING EVAPOTRANSPIRATION IN SOIL MONOLITHS,
W69-05270 02D

EXPANSIVE SOILS
HYDRAULIC CONDUCTIVITY RELATED TO POROSITY AND SWELLING OF SOIL,
W69-05443 02G

EXPENDITURES
ECONOMICS AND FINANCING OF IRRIGATION PROJECTS.
W69-05221 06C

EXPROPRIATION
DICKSON V BOARD OF COMM'RS OF CADDO LEVEE (EXPROPRIATION OF RIPARIAN LAND BY THE STATE).
W69-05585 06E

FACTOR ANALYSIS
FACTOR ANALYSIS AND REGRESSION,
W69-05517 06B

FAIR MARKET VALUE
DILLENBECK V STATE (COMPENSATION FOR PERPETUAL EASEMENT TO FLOOD LAND).
W69-05573 06E

FARM MANAGEMENT
JONES V LUCAS (SURFACE DRAINAGE).
W69-05594 04A

FARM WASTE
NITROGEN CYCLE IN SURFACE AND SUBSURFACE WATERS,
W69-05323 05B

FARM WASTES
WATER QUALITY CHANGES IN CONFINED HOG WASTE TREATMENT,
W69-05417 05D

FEDERAL CONSTITUTION
WATER LAW, POLITICS, AND ECONOMICS FEDERAL CONTROL OF WATER RESOURCES,
W69-05297 06E

FEDERAL GOVERNMENT
UNITED STATES V WILLIS (ARBITRARINESS IN LAND CONDEMNATION).
W69-05574 06E

FEDERAL JURISDICTION
WATER LAW, POLITICS, AND ECONOMICS FEDERAL CONTROL OF WATER RESOURCES,
W69-05297 06E

FIELD CAPACITY
MOISTURE-RETENTION CAPACITY OF LITTER UNDER TWO ARIZONA CHAPARRAL COMMUNITIES,
W69-05267 02G

FILTERS
RAPID FIELD FILTRATION OF WATER SAMPLES,
W69-05244 07B

FILTRATION
RAPID FIELD FILTRATION OF WATER SAMPLES,
W69-05244 07B

FINANCING
DELAWARE RIVER BASIN COMPACT.
W69-05345 04D

FIRST DIFFERENCES
AUTOCORRELATION BETWEEN FIRST DIFFERENCES OF MID-RANGES,
W69-05520 06B

FISH
NOTICE OF PETITIONS FOR SPECIAL LEGISLATION PERTAINING TO FISH AND GAME.
W69-05375 06E

TRESPASS - IMPROVED LANDS AND FISH PONDS.
W69-05566 06E

FISH MANAGEMENT
RESERVOIR FISHERY RESOURCES,
W69-05463 02H

FISHKILL
A LIMNOLOGICAL RECONNAISSANCE OF AN IMPOUNDMENT RECEIVING HEAVY METALS WITH EMPHASIS OF DIATOMS AND FISH,
W69-05465 02H

MASONITE CORPORATION V GUY (FISHKILL EFFECTS OF WATER POLLUTION).
W69-05553 05C

FLASH FLOODS
CARLSON V A AND P CORRUGATED BOX CORP (FLOODING CAUSED BY NEGLIGENT MAINTENANCE OF DAM).
W69-05588 04A

FLOC FORMATION
IDENTIFICATION OF ZOOGLOEA SPECIES AND THE RELATIONSHIP TO ZOOGLOEAL MATRIX AND FLOC FORMATION,
W69-05313 05C

FLOOD CONTROL
FLAT CHANNEL TERRACES,
W69-05282 02J

FLOOD DAMAGE
FLOOD PLAIN INFORMATION, SOUTHWEST BRANCH, PRINCE GEORGES COUNTY, MARYLAND.
W69-05203 04A

FLOOD PLAIN INFORMATION (ANACOSTIA RIVER), PRINCE GEORGES COUNTY, MARYLAND.
W69-05204 04A

FLOOD PLAIN INFORMATION, INTRENCHMENT, SUGAR, DOOLITTLE AND DOLESS CREEKS.
W69-05205 04A

FLOOD PLAIN INFORMATION OF PROCTOR CREEK, METROPOLITAN ATLANTA, GEORGIA.
W69-05206 04A

FLOOD PLAIN INFORMATION ON HEADWATERS SOUTH RIVER, METROPOLITAN ATLANTA, GEORGIA.
W69-05207 04A

EAST FORK DUCK CREEK WATERSHED NOBLE AND WASHINGTON COUNTIES, OHIO.
W69-05329 06B

JOHNSON V CITY OF WINSTON-SALEM (ACTION FOR DAMAGES CAUSED BY AN OBSTRUCTED DRAIN PIPE).
W69-05394 04A

FLOOD PLAIN INFORMATION OF ELLICOTT CREEK IN CITY OF TONAWANDA AND VICINITY, ERIE COUNTY, NEW YORK.
W69-05458 02E

FLOOD PLAIN INFORMATION OF DUCK CREEK, GARLAND, TEXAS.
W69-05459 02E

FLOOD PLAIN INFORMATION, SOUTH MESQUITE CREEK, MESQUITE, TEXAS.
W69-05460 02E

FLOOD PLAIN INFORMATION, TENNILE CREEK, DALLAS COUNTY, TEXAS.
W69-05461 02E

FLOOD PLAIN INFORMATION OF CATTARAUGUS CREEK, ARCADE, WYOMING COUNTY, NEW YORK.
W69-05462 02E

TOWN OF VIENNA V STATE (PRESCRIPTIVE RIGHTS DOCTRINE AS APPLIED TO PUBLIC PROPERTY).
W69-05549 04A

TANEY COUNTY V EMPIRE DIST ELECTRIC CO (FLOOD DAMAGE AND CLAIM SETTLEMENT FOR FUTURE DAMAGES).
W69-05571 06E

EAVES V CITY OF OTTUMWA (LIABILITY FOR FLOOD DAMAGE).
W69-05587 06E

IODICE V STATE (DUTIES OF DAM OWNERS).
W69-05589 06E

GOLDEN V AMORY (LIABILITY FOR FLOODING).
W69-05590 06E

TAYLOR V STATE (PRESCRIPTIVE RIGHT TO FLOOD LAND).
W69-05592 06E

FLOOD FORECASTING
THE ASSESSMENT OF SURFACE RUNOFF FROM RAINFALL DATA FOR AN ARID REGION OF WEST PAKISTAN,
W69-05232 02E

COMPARISON OF FLOOD-WAVE AND WATER-PARTICLE TRAVELTIMES,
W69-05240 02E

INTERPRETATION OF FLOOD-FREQUENCY DATA,
W69-05260 07B

THE WEATHER BUREAU AND WATER MANAGEMENT.
W69-05336 07C

FREQUENCY CURVES FOR ANNUAL FLOOD SERIES WITH SOME ZERO EVENTS OR INCOMPLETE DATA,
W69-05455 07C

FLOOD PLAIN ZONING
THE PLAN AND PROGRAM FOR THE BRANDYWINE.
W69-05299 06B

FLOOD PLAINS
FLOOD PLAIN INFORMATION, SOUTHWEST BRANCH, PRINCE GEORGES COUNTY, MARYLAND.
W69-05203 04A

FLOOD PLAIN INFORMATION (ANACOSTIA RIVER), PRINCE GEORGES COUNTY, MARYLAND.
W69-05204 04A

FLOOD PROTECTION
EAST FORK DUCK CREEK WATERSHED NOBLE AND WASHINGTON COUNTIES, OHIO.
W69-05329 06B

FLOOD ROUTING
MOUNTAIN RIVER FLOOD RUNOFF THEORY, MEANS OF ITS INVESTIGATION AND CALCULATION,
W69-05230 02A

FLOOD WATERS
BUDA V STATE (ARTIFICIAL CONTROL OF SURFACE WATERS).
W69-05550 04A

FLOODS
FLOOD PLAIN INFORMATION, SOUTHWEST BRANCH, PRINCE GEORGES COUNTY, MARYLAND.
W69-05203 04A

FLOOD PLAIN INFORMATION (ANACOSTIA RIVER), PRINCE GEORGES COUNTY, MARYLAND.
W69-05204 04A

FLOOD PLAIN INFORMATION, INTRENCHMENT, SUGAR, DOOLITTLE AND DOLESS CREEKS.
W69-05205 04A

FLOOD PLAIN INFORMATION OF PROCTOR CREEK, METROPOLITAN ATLANTA, GEORGIA.
W69-05206 04A

FLOOD PLAIN INFORMATION ON HEADWATERS SOUTH RIVER, METROPOLITAN ATLANTA, GEORGIA.
W69-05207 04A

STUDIES OF RUNOFF FORMATION UNDER CONDITION OF HIGH-ANGLE ATTITUDE OF THE IMPERVIOUS BED,
W69-05229 02E

COMPARISON OF FLOOD-WAVE AND WATER-PARTICLE TRAVELTIMES,
W69-05240 02E

INTERPRETATION OF FLOOD-FREQUENCY DATA,
W69-05260 07B

FLOODS IN VIRGINIA - MAGNITUDE AND FREQUENCY,
W69-05415 02E

FLOOD PLAIN INFORMATION OF ELLICOTT CREEK IN CITY OF TONAWANDA AND VICINITY, ERIE COUNTY, NEW YORK.
W69-05458 02E

FLOOD PLAIN INFORMATION OF DUCK CREEK, GARLAND, TEXAS.
W69-05459 02E

FLOOD PLAIN INFORMATION, SOUTH MESQUITE CREEK, MESQUITE, TEXAS.
W69-05460 02E

FLOOD PLAIN INFORMATION, TENMILE CREEK, DALLAS COUNTY, TEXAS.
W69-05461 02E

FLOOD PLAIN INFORMATION OF CATTARAUGUS CREEK, ARCADE, WYOMING COUNTY, NEW YORK.
W69-05462 02E

FLORIDA
TECHNIQUES OF WATER MANAGEMENT OF LAKE OKEECHOBEE AND THE FLORIDA EVERGLADES,
W69-05223 04A

MEYER V CITY OF OAKLAND (VALIDITY OF SPECIAL ASSESSMENTS TO LAND FOR SEWER IMPROVEMENTS).
W69-05542 06E

LAWRENCE V EASTERN AIRLINES (DIVERSION OF NATURAL FLOW).
W69-05546 04A

BRAY V CITY OF WINTER GARDEN (SURFACE WATERS CAST ON LOWER PROPERTY).
W69-05563 04A

FLOW NETS
FLUID FLOW IN THE WESTERN CANADA SEDIMENTARY BASIN - 1. EFFECT OF TOPOGRAPHY,
W69-05451 02F

FLUCTUATION
PESTICIDE LEVELS AND FLUCTUATION IN SOIL BACTERIA IN AN IRRIGATED FIELD AND A POND OF SOUTHWEST TEXAS,
W69-05272 05C

FLUIDIZED BED SEEDING
BASIC STUDIES OF SCALE CONTROL,
W69-05334 03A

W69-05334 03A

FLUORESCENCE
IMPROVED DYES FOR WATER TRACING,
W69-05235 07B

FOLIAR APPLICATION
SOIL OR FOLIAR FERTILIZATION OF WELL-DRAINED AND FLOODED SLASH PINE,
W69-05332 02G

FOODS
PESTICIDES NOT ENOUGH KNOWN.
W69-05215 05G

FORAGE GRASSES
EFFECT OF MOISTURE REGIMES AND HARVESTS ON EFFICIENCY OF WATER USE BY TEN FORAGE CROPS,
W69-05268 02I

FORAGE LEGUMES
EFFECT OF MOISTURE REGIMES AND HARVESTS ON EFFICIENCY OF WATER USE BY TEN FORAGE CROPS,
W69-05268 02I

FORECASTING
PREDICTING FIELD DISTRIBUTIONS OF SPRINKLER SYSTEMS,
W69-05285 03F

EVALUATION OF PRE-IMPOUNDMENT CONDITIONS FOR PREDICTION OF STORED WATER QUALITY,
W69-05468 02H

FORT LOUDOUN RESERVOIR(TENN)
WATER QUALITY INVESTIGATION, PART 1 - BASIC DATA, FORT LOUDOUN RESERVOIR, APRIL 1966 - JUNE 1968,
W69-05416 05A

FREE GOODS
A NOTE ON THE DUAL PRICES OF INTEGER PROGRAMS,
W69-05523 06C

FRESH WATER
DETERMINATION OF FRESH WATERS IN THE CALCAREOUS MASSIF OF 'COSTA BRAVA', SPAIN (FRENCH),
W69-05478 02F

GAME BIRDS
NOTICE OF PETITIONS FOR SPECIAL LEGISLATION PERTAINING TO FISH AND GAME.
W69-05375 06E

TRESPASS - IMPROVED LANDS AND FISH PONDS.
W69-05566 06E

GEOLOGY
SALT-WATER ENCROACHMENT OF TERTIARY LIMESTONE ALONG COASTAL SOUTH CAROLINA,
W69-05473 02L

GEORGIA
W B RODDENBERY CO INC V CARTER (DAMAGES FOR POLLUTION OF STREAM).
W69-05559 05B

GLACIAL SOILS
HYDROLOGY OF A SLIDE-PRONE GLACIAL TILL SOIL IN SOUTHEAST ALASKA,
W69-05406 02G

GOVERNMENTS
THE ORGANIZATION OF VENEZUELA FOR THE UTILIZATION OF ITS WATER RESOURCES (SPANISH),
W69-05220 06E

ECONOMIC ALTERNATIVES,
W69-05528 05G

GRANITES
GRANITES, GRUSSES, AND THE SHERMAN EROSION SURFACE, SOUTHERN LARAMIE RANGE, COLORADO-WYOMING,
W69-05211 02J

GRASSED WATERWAYS
ENGINEERING TECHNIQUES AND PRINCIPLES APPLIED TO SOIL EROSION CONTROL,
W69-05333 04D

GRASSES
SOIL MOISTURE CONDITIONS UNDER PASTURES OF COOL-SEASON AND WARM-SEASON GRASSES,
W69-05266 02G

SOIL PROBLEMS IN RESEEDING A GREASEWOOD-RABBITBRUSH RANGE SITE,
W69-05269 02G

GRAVELS
TENNESSEE VALLEY SAND AND GRAVEL CO V PILLING (LIABILITY FOR SEDIMENT DUMPING WHICH MAKES CREEK BED SHALLOWER, WHICH CAUSES MORE FLOODING).
W69-05386 05G

GRAZING
SOIL MOISTURE CONDITIONS UNDER PASTURES OF COOL-SEASON AND WARM-SEASON GRASSES,
W69-05266 02G

GREASEWOOD
SOIL PROBLEMS IN RESEEDING A GREASEWOOD-RABBITBRUSH RANGE SITE,
W69-05269 02G

GREAT LAKES
HYDROMETEOROLOGICAL STUDIES IN SUPPORT OF THE INTERNATIONAL FIELD YEAR FOR THE GREAT LAKES,
W69-05222 02B

GREECE
SALT WATER ENCROACHMENT IN KARST AQUIFERS, ISLAND OF KEPHALLINIA, (IONIAN),
W69-05472 02L

GROUND WATER RECHARGE
PUTTING WASTE WATER TO BENEFICIAL USE - THE FLUSHING MEADOWS PROJECT,
W69-05327 05D

RETURNING WASTES TO THE LAND, A NEW ROLE FOR AGRICULTURE,
W69-05328 05D

GROUNDWATER
VARIATION IN THE COMPOSITION OF BRINE FROM THE SYLVANIA FORMATION NEAR MIDLAND, MICHIGAN,
W69-05401 02F

WATER-RESOURCES APPRAISAL OF THE SNAKE RIVER BASIN IN NEVADA,
W69-05414 02E

EVALUATION OF SOME GEOPHYSICAL TECHNIQUES APPLIED TO THE ENVIRONMENT OF A MAUI WELL,
W69-05418 02F

WATER RESOURCES OF THE BURNETT REGION,
W69-05423 02E

WATER SUPPLY IN THE BRACKISH-WATER REGIONS OF SOUTH VIETNAM.
W69-05457 02L

GROUNDWATER BASINS
IDENTIFICATION OF NONLINEAR PARAMETERS OF GROUND WATER BASINS BY HYBRID COMPUTATION,
W69-05271 02F

GROUNDWATER MOVEMENT
TRANSIENT FLOW OF GROUND WATER TO WELLS IN MULTIPLE-AQUIFER SYSTEMS,
W69-05413 02F

MEASUREMENT OF SMALL SURFACE DISPLACEMENTS INDUCED BY FLUID FLOW,
W69-05433 02F

FLUID FLOW IN THE WESTERN CANADA SEDIMENTARY BASIN - 1. EFFECT OF TOPOGRAPHY,
W69-05451 02F

DETERMINING THE RATIO OF HORIZONTAL TO VERTICAL PERMEABILITY BY AQUIFER-TEST ANALYSIS,
W69-05452 02F

GRUSSES
GRANITES, GRUSSES, AND THE SHERMAN EROSION SURFACE, SOUTHERN LARAMIE RANGE, COLORADO-WYOMING,
W69-05211 02J

HANNAN'S THEOREM
AN ALTERNATIVE PROOF OF HANNAN'S THEOREM ON CANONICAL CORRELATION AND MULTIPLE EQUATION SYSTEMS,
W69-05511 06D

HARBOR MASTERS
HARBORS, WHARVES, AND HARBOR MASTERS.
W69-05377 04A

HARBORS
HARBOR DEVELOPMENT PORT OF PORTLAND, MAINE.
W69-05298 06B

HARBORS, WHARVES, AND HARBOR MASTERS.
W69-05377 04A

EQUILIBRIUM FLOW AREAS OF INLETS ON SANDY COASTS,
W69-05447 02L

HARMONIC REGRESSION
LONG SWINGS,
W69-05498 06B

HARVESTING
EFFECT OF MOISTURE REGIMES AND HARVESTS ON EFFICIENCY OF WATER USE BY TEN FORAGE CROPS,
W69-05268 02I

HAWAII
EVALUATION OF SOME GEOPHYSICAL TECHNIQUES APPLIED TO THE ENVIRONMENT OF A MAUI WELL,
W69-05418 02F

HEAT BUDGET
PREDICTING TEMPERATURES OF SMALL STREAMS,
W69-05427 02E

HIGH WATER MARK
MINIMUM AND MAXIMUM WATER-LEVEL RECORDING DEVICES,
W69-05250 07B

IN RE SITE FOR HUNTS POINT SEWAGE TREATMENT WORKS, BOROUGH OF BRONX, CITY OF NEW YORK (OWNERSHIP OF LAND UNDER WATER).
W69-05581 06E

HIGHWAYS
HIGHWAYS.
W69-05378 04C

W69-05379 04C

HISTORY
WATER LAW, POLITICS, AND ECONOMICS OUR COMPLEX WATER LAWS AND WATER USE CUSTOMS,
W69-05296 06E

HOGS
WATER QUALITY CHANGES IN CONFINED HOG WASTE TREATMENT,
W69-05417 05D

HUMAN RESOURCES
INTERGRATING HUMAN-SOCIAL RESOURCES INTO THE WATER RESOURCE DEVELOPMENT PROJECT,
W69-05217 06B

HUNTING
SALT WATER ISLANDS.
W69-05565 06E

HURRICANES
MASSMAN-DRAKE V TOWBOAT M/V HUGH C BLASKE, BARGE CHEM 2 (ACTION FOR DAMAGES CAUSED BY A TOWBOAT CAST ADRIFT BY A HURRICANE).
W69-05341 06E

HYBRID COMPUTERS
IDENTIFICATION OF NONLINEAR PARAMETERS OF GROUND WATER BASINS BY HYBRID COMPUTATION,
W69-05271 02F

HYDRAULIC CONDUCTIVITY
HYDRAULIC CONDUCTIVITY RELATED TO POROSITY AND SWELLING OF SOIL,
W69-05443 02G

HYDRAULIC ENGINEERING
ENGINEERING TECHNIQUES AND PRINCIPLES APPLIED TO SOIL EROSION CONTROL,
W69-05333 04D

HYDRAULIC MODELS
DESIGN CRITERIA FOR LABORATORY CATCHMENT EXPERIMENTS, WITH PARTICULAR REFERENCE TO RAINFALL SIMULATION,
W69-05234 02A

PREDICTION OF SEDIMENT PROFILES IN OPEN CHANNEL FLOW BY TURBULENT DIFFUSION THEORY,
W69-05403 02J

SHOALING OF SOLITARY WAVES ON SMALL SLOPES,
W69-05450 02H

HYDRAULIC OBSERVATIONS
PROBLEMS OF THE METHODS AND ACCURACY OF HYDROLOGIC OBSERVATIONS (RUSSIAN),
W69-05210 07A

HYDROELECTRIC POWER
DELAWARE RIVER BASIN COMPACT.
W69-05345 04D

HYDROGRAPH ANALYSIS
COMPARATIVE STUDY OF SNOW TYPE HYDROLOGY OF NORTHEASTERN CANADA AND OF PLAINS OF RUSSIA AND SIBERIA,
W69-05225 02E

HYDROGRAPHS
COMPARATIVE STUDY OF SNOW TYPE HYDROLOGY OF NORTHEASTERN CANADA AND OF PLAINS OF RUSSIA AND SIBERIA,
W69-05225 02E

SYNTHETIC HYDROGRAPHS. EFFECTS OF NETWORK GEOMETRY,
W69-05432 02A

RUNOFF HYDROGRAPH AS A FUNCTION OF RAINFALL EXCESS,
W69-05438 02A

HYDROLOGIC ASPECTS
HYDROLOGY OF A SLIDE-PRONE GLACIAL TILL SOIL IN SOUTHEAST ALASKA,
W69-05406 02G

HYDROLOGIC EFFECTS OF THE 1962-66 DROUGHT ON LONG ISLAND, N. Y.,
W69-05411 02A

HYDROLOGIC CYCLE
WATER RESOURCES LAWS IN VIRGINIA (REMEDIES FOR INFRINGEMENT OF WATER RIGHTS).
W69-05538 06E

HYDROLOGIC PROPERTIES
DETERMINATION OF FRESH WATERS IN THE CALCAREOUS MASSIF OF 'COSTA BRAVA', SPAIN (FRENCH),
W69-05474 02F

HYDROLOGY
THE WEATHER BUREAU AND WATER MANAGEMENT.
W69-05336 07C

HYGROMETRY
SERVOPSYCHROMETER,
W69-05251 07B

ISOPIESTIC TECHNIQUE FOR MEASURING LEAF WATER POTENTIALS WITH A THERMOCOUPLE PSYCHROMETER,
W69-05286 02I

HYPOLIMNION
EFFECT OF IMPOUNDMENTS ON PRODUCTIVITY, WATER CHEMISTRY, AND HEAT BUDGETS OF RIVERS,
W69-05469 02H

ILLINOIS
PEOPLE V VILLAGE OF BERKELEY (STATUTORY DUTIES UNDER WATER SUPPLY CONTRACTS).
W69-05584 06E

IMPAIRED WATER QUALITY
QUALITY WATER'S FOURTH DIMENSION,
W69-05524 05G

THE COMPETITION FOR WATER QUALITY AGRICULTURE,
W69-05525 05G

IMPLEMENTATION TECHNIQUES
WATER RESOURCES POLICY AND POLITICAL INSTITUTIONS.
W69-05295 06B

IMPOUNDED WATERS
WATER RESOURCES LAWS IN VIRGINIA (PERCOLATING GROUNDWATER - DIFFUSED SURFACE WATER).
W69-05535 06E

IMPOUNDMENTS
WATER QUALITY IN IMPOUNDMENTS AND MODIFICATIONS FROM DESTRATIFICATION,
W69-05467 02H

INCOME
AN INCOME-NET WORTH APPROACH TO MEASURING ECONOMIC WELFARE,
W69-05290 06B

THE ECONOMICS OF WATER ALLOCATION IN UTAH,
W69-05507 06D

INCREASING RETURNS TO SCALE
INCREASING OR DECREASING RETURNS TO SCALE IN THE CONSTANT ELASTICITY OF SUBSTITUTION PRODUCTION FUNCTION,
W69-05505 06D

INDIA
ECONOMICS AND FINANCING OF IRRIGATION PROJECTS,
W69-05221 06C

MEASUREMENT OF DROUGHT RESISTANCE IN CROP PLANTS,
W69-05265 02G

INDIANA
NEWTON V LYONS (COMMON ENEMY EXCEPTION).
W69-05545 06E

GWINN V MYERS (SUIT TO REMOVE OBSTRUCTION TO NATURAL WATERCOURSE).
W69-05557 04A

INDUSTRIAL PLANTS
W B RODDENBERY CO INC V CARTER (DAMAGES FOR POLLUTION OF STREAM).
W69-05559 05B

INDUSTRIAL WASTES
GARGAC V SMITH-ROWLAND CO (POLLUTION OF LAKE BY INDUSTRIAL WASTES).
W69-05387 05C

TREATING COKE PLANT WASTE,
W69-05422 05D

INDUSTRIES
THE COMPETITION FOR WATER QUALITY INDUSTRY,
W69-05526 05G

INFILTRATION
SOIL PROBLEMS IN RESEEDING A GREASEWOOD-RABBITBRUSH RANGE SITE,
W69-05269 02G

THE MECHANISM OF NATURAL GROUND-WATER RECHARGE AND DISCHARGE 1. ONE-DIMENSIONAL, VERTICAL, UNSTEADY, UNSATURATED FLOW ABOVE A RECHARGING OR DISCHARGING GROUND-WATER FLOW SYSTEM,
W69-05436 02F

INFORMATION RETRIEVAL
DATA SYSTEMS AND INFORMATION RETRIEVAL ADAPTABLE TO WATER RESOURCES,
W69-05490 06B

A DISCUSSION OF DATA SYSTEMS AND INFORMATION RETRIEVAL ADAPTABLE TO WATER RESOURCES,
W69-05491 06B

INLAND WATERWAYS
THE ORIGIN AND DEVELOPMENT OF THE WATERWAYS POLICY OF THE UNITED STATES,
W69-05338 04A

INLETS
WATERWAYS AND WATER FRONTS.
W69-05364 04A

INPUT-OUTPUT ANALYSIS
THE ECONOMICS OF WATER ALLOCATION IN UTAH,
W69-05507 06D

THE INTERINDUSTRY FACTOR-CONTEXT MATRIX AN APPLICATION FOR THE ANALYSIS AND PROJECTION OF REGIONAL WATER REQUIREMENTS,
W69-05509 06B

INSTITUTIONAL CONSTRAINTS
A LAWYER LOOKS AT WATER RESOURCE ECONOMICS,
W69-05292 06E

WATER RESOURCES POLICY AND POLITICAL INSTITUTIONS.
W69-05295 06B

INSTRUMENTATION
WATER-MANOMETER-AIR-LINE ASSEMBLY FOR DETERMINING DEPTH TO WATER IN WELLS,
W69-05249 07B

MINIMUM AND MAXIMUM WATER-LEVEL RECORDING DEVICES,
W69-05250 07B

SERVOPSYCHROMETER,
W69-05251 07B

RAFT FOR EVAPORATION-MEASUREMENT EQUIPMENT,
W69-05252 07B

WATER-STAGE AND RAINFALL DUAL RECORDER,
W69-05253 07B

POLAR COORDINATE CHART READER FOR STAGE-RAINFALL RECORDER,
W69-05254 07B

AN ACCURATE SMALL ORIFICE RAIN GAGE,
W69-05404 07B

INTEGER PROGRAMS
A NOTE ON THE DUAL PRICES OF INTEGER PROGRAMS,
W69-05523 06C

INTERCEPTION
THE INTERCEPTION-TRANSPIRATION RELATIONSHIP OF WHITE SPRUCE AND WHITE PINE,
W69-05274 02D

INTERDISCIPLINARY RESEARCH
CONCEPTUAL ISSUES IN THE CONDUCT OF REGIONAL RESEARCH ON THE ECONOMICS OF WATER,
W69-05480 06B

INTERNATIONAL HYDROLOGICAL DECADE
HYDROMETEOROLOGICAL STUDIES IN SUPPORT OF THE INTERNATIONAL FIELD YEAR FOR THE GREAT LAKES,
W69-05222 02B

INTERSTATE COMPACTS
DELAWARE RIVER BASIN COMPACT.
W69-05342 04A

W69-05343 04A

W69-05344 04A

INTERSTATE RIVERS
THE ORIGIN AND DEVELOPMENT OF THE WATERWAYS POLICY OF THE UNITED STATES,
W69-05338 04A

INTER-BASIN TRANSFERS
WATER RESOURCES LAWS IN VIRGINIA (REMEDIES FOR INFRINGEMENT OF WATER RIGHTS).
W69-05538 06E

INVESTMENT
WATER RESOURCE DEVELOPMENT PUBLIC AND PRIVATE INVESTMENT,
W69-05486 06B

DISCUSSION OF WATER RESOURCE DEVELOPMENT PUBLIC AND PRIVATE INVESTMENT,
W69-05487 06B

IOWA

LEGAL ASPECTS OF THE SMALL WATERSHED PROGRAM IN IOWA,
W69-05339 04D

DODD V BLEZEK (DETERMINATION OF DOMINANT ESTATE AND DRAINAGE RIGHTS IN NATURAL STREAM).
W69-05393 04A

BOAT V VAN VEEN (INTERFERENCE WITH WATER FLOW).
W69-05395 04A

DROGMILLER V OLSON (OBSTRUCTION TO NATURAL COURSE OF DRAINAGE).
W69-05547 04A

EAVES V CITY OF OTTUMWA (LIABILITY FOR FLOOD DAMAGE).
W69-05587 06E

NIXON V WELCH (SURFACE DRAINAGE EASEMENTS).
W69-05593 04A

IRRIGATED LAND
PESTICIDE LEVELS AND FLUCTUATION IN SOIL BACTERIA IN AN IRRIGATED FIELD AND A POND OF SOUTHWEST TEXAS,
W69-05272 05C

IRRIGATION
ECONOMICS AND FINANCING OF IRRIGATION PROJECTS,
W69-05221 06C

WATER RESOURCES OF THE BURNETT REGION,
W69-05423 02E

IRRIGATION CAPITAL
ECONOMICS AND FINANCING OF IRRIGATION PROJECTS,
W69-05221 06C

IRRIGATION EFFICIENCY
VARIABLE ROW SPACING OF IRRIGATED COTTON AS A MEANS FOR REDUCING PRODUCTION COSTS AND CONSERVING WATER,
W69-05277 03F

WATER MANAGEMENT OF FALL-PLANTED SUGAR BEETS IN SALT RIVER VALLEY OF ARIZONA,
W69-05279 03F

DETERMINATION OF OPTIMUM CAPACITY OF A STORAGE RESERVOIR FOR IRRIGATION PURPOSES AS A BASIS FOR ALLOCATING COSTS IN MULTIPLE-PURPOSE PROJECTS,
W69-05294 03F

IRRIGATION POTENTIAL
ECONOMICS AND FINANCING OF IRRIGATION PROJECTS,
W69-05221 06C

IRRIGATION PRACTICES
STUDIES ON WATER USE IN PEA (PISUM SATIVUM L.),
W69-05287 03F

IRRIGATION SYSTEMS
PREDICTING FIELD DISTRIBUTIONS OF SPRINKLER SYSTEMS,
W69-05285 03F

IRRIGATION WATER
THE COMPETITION FOR WATER QUALITY AGRICULTURE,
W69-05525 05G

ISLANDS
SALT WATER ISLANDS.
W69-05565 06E

ISOPIESTIC
.ISOPIESTIC TECHNIQUE FOR MEASURING LEAF WATER POTENTIALS WITH A THERMOCOUPLE PSYCHROMETER,
W69-05286 02I

ITALIAN HYDRAULIC RECLAMATION
ENGINEERING TECHNIQUES AND PRINCIPLES APPLIED TO SOIL EROSION CONTROL,
W69-05333 04D

ITERATION
A COMMENT ON OPTIMIZATION METHODS FOR BRANCHING MULTISTAGE WATER RESOURCE SYSTEMS,
W69-05499 06A

OPTIMIZATION METHODS FOR BRANCHING MULTISTAGE WATER RESOURCE SYSTEMS--A REPLY TO A COMMENT BY E. F. BRATER,
W69-05501 06A

JUDICIAL DECISIONS
WATER LAW, POLITICS, AND ECONOMICS FEDERAL CONTROL OF WATER RESOURCES,
W69-05297 06E

PENN CENTRAL CO V BUCKLEY AND CO (BRIDGE COLLISIONS SUIT).
W69-05380 06E

KARST
SALT WATER ENCROACHMENT IN KARST AQUIFERS, ISLAND OF KEPHALLINIA, (IONIAN),
W69-05472 02L

KENTUCKY
JOHNSON V RAY (RIGHT TO CONSTRUCT RETAINING WALL)
W69-05382 04A

GREEN V MCCLOUD (ACTION TO ENJOIN SEWAGE FLOW).
W69-05389 05G

LEWALLEN V DAVENPORT (DAMAGE FROM BACKING SURFACE RUNOFF).
W69-05600 04A

LABORATORY CATCHMENT EXPERIMENTS
DESIGN CRITERIA FOR LABORATORY CATCHMENT EXPERIMENTS, WITH PARTICULAR REFERENCE TO RAINFALL SIMULATION,
W69-05234 02A

LABORATORY TESTS
DESIGN CRITERIA FOR LABORATORY CATCHMENT EXPERIMENTS, WITH PARTICULAR REFERENCE TO RAINFALL SIMULATION,
W69-05234 02A

LAKE SENECA
CRANCE V STATE (DAMAGES FOR APPROPRIATION OF RIPARIAN RIGHTS BY THE STATE).
W69-05580 06E

LAKES
TECHNIQUES OF WATER MANAGEMENT OF LAKE OKEECHOBEE AND THE FLORIDA EVERGLADES,
W69-05223 04A

STATE V BOLLENBACK (NAVIGABILITY OF LAKE).
W69-05576 06E

LAND RECLAMATION
PUBLIC PARKS - PLAYGROUNDS SALE OF RECLAIMED LANDS ABUTTING PARK LANDS.
W69-05365 06E

LAND TENURE
CONVEYANCES OF LANDS BY LEGISLATIVE AUTHORITY.
W69-05348 06E

SURVEY OPERATIONS AND CONTROLS BY THE BOARD OVER SUBMERGED LANDS.
W69-05350 06E

CONFIRMATORY LEASES AND GRANTS OF SUBMERGED LAND.
W69-05354 06E

ERRONEOUS GRANTS OF SUBMERGED LAND.
W69-05355 06E

DELINQUENT RIPARIAN LEASES RE-ENTRY BY THE STATE.
W69-05356 06E

STATE ACQUISITION OF RIPARIAN LANDS LEASE FOR COMMERCIAL ENTERPRISES.
W69-05358 06E

LAND USAGE
STATE ACQUISITION OF RIPARIAN LANDS LEASE FOR COMMERCIAL ENTERPRISES.
W69-05358 06E

LAND USE
HARBOR DEVELOPMENT PORT OF PORTLAND, MAINE.
W69-05298 06B

THE PLAN AND PROGRAM FOR THE BRANDYWINE.
W69-05299 06B

LANDFILLS
POIRE V SERRA (PROPRIETY OF LAND FILL BY RIPARIAN OWNER).
W69-05381 04A

LANDSLIDES
HYDROLOGY OF A SLIDE-PRONE GLACIAL TILL SOIL IN SOUTHEAST ALASKA,
W69-05406 02G

LEAVES
TISSUE WATER RELATIONS FOR BRIGALOW AND MULGA,
W69-05281 02I

ISOPIESTIC TECHNIQUE FOR MEASURING LEAF WATER POTENTIALS WITH A THERMOCOUPLE PSYCHROMETER,
W69-05286 02I

SEASONAL AND DIURNAL VARIATION IN POCOSIN SHRUB MOISTURE CONTENT,
W69-05331 02I

LEGAL ASPECTS
LEGAL CONSTRAINTS IN WATER PRICING POLICY,
W69-05493 06C

MEYER V CITY OF OAKLAND (VALIDITY OF SPECIAL ASSESSMENTS TO LAND FOR SEWER IMPROVEMENTS).
W69-05542 06E

LEGISLATION
USAGE OF SUBMERGED LAND LEASE AND GRANT CONDITIONS AND PROCEDURE.
W69-05351 06E

DAMAGE TO ICE.
W69-05371 06E

MOORING WATERCRAFT TO BUOYS OR BEACONS.
W69-05373 06E

UNWHOLESOME PREMISES REMOVAL AND REHABILITATION AT OWNER'S EXPENSE.
W69-05376 05B

HARBORS, WHARVES, AND HARBOR MASTERS.
W69-05377 04A

HIGHWAYS.
W69-05378 04C

W69-05379 04C

COMPLETION OF THE FAIRFAX COUNTY WATER AUTHORITY ACQUISITION PROGRAM.
W69-05539 03D

LEGUMES
DROUGHT AND PHOSPHORUS AFFECT GROWTH OF ANNUAL FORAGE LEGUMES,
W69-05264 02I

LEVEES
CITY OF HARDIN V NORBORNE LAND DRAINAGE DISTRICT (STATUTORY RIGHTS TO MAINTAIN EXISTING LEVEES).
W69-05384 04A

BOAT V VAN VEEN (INTERFERENCE WITH WATER FLOW).
W69-05395 04A

DICKSON V BOARD OF COMM'RS OF CADDO LEVEE (EXPROPRIATION OF RIPARIAN LAND BY THE STATE).
W69-05585 06E

LEVEL PANS
RUNOFF WATER-SPREADING ON LEVELED CROPLAND,
W69-05275 04A

LIGHT
STOMATAL OPENING IN ISOLATED EPIDERMAL STRIPS OF VICIA FABA. I. RESPONSE TO LIGHT AND TO CO2-FREE AIR,
W69-05278 02I

LIMESTONES
SALT-WATER ENCROACHMENT OF TERTIARY LIMESTONE ALONG COASTAL SOUTH CAROLINA,
W69-05473 02L

DETERMINATION OF FRESH WATERS IN THE CALCAREOUS MASSIF OF 'COSTA BRAVA', SPAIN (FRENCH),
W69-05474 02F

LINEAR PROGRAMMING
WATER POLLUTION CONTROL USING BY-PASS PIPING,
W69-05503 05G

A NOTE ON THE DUAL PRICES OF INTEGER PROGRAMS,
W69-05523 06C

LITTER LAYER
MOISTURE-RETENTION CAPACITY OF LITTER UNDER TWO ARIZONA CHAPARRAL COMMUNITIES,
W69-05267 02G

LOANS
CAPITAL FORMATION AND GOVERNMENT CAPITAL POLICY IN DEVELOPING ECONOMIES,
W69-05518 06C

LOCAL GOVERNMENTS
GRANTS OF SUBMERGED LANDS TO THE STATE, MUNICIPALITIES, AND OTHER SUBDIVISIONS.
W69-05353 06E

UNWHOLESOME PREMISES REMOVAL AND REHABILITATION AT OWNER'S EXPENSE.
W69-05376 05B

HIGHWAYS.
W69-05378 04C

W69-05379 04C

DEYO V ATHOL HOUSING AUTHORITY (DAMAGE FROM WATER DISCHARGE).
W69-05556 04C

LOGGING(RECORDING)
AN OUTLINE OF GEOPHYSICAL LOGGING METHODS AND THEIR USES IN HYDROLOGIC STUDIES,
W69-05261 07B

LONG CYCLES
LONG SWINGS,
W69-05498 06B

LONG ISLAND
TRUSTEES OF FREEHOLDERS AND COMMONALTY V MORRISEY (TITLE TO BEDS UNDER TIDAL WATERS).
W69-05388 06E

LONG SWINGS
LONG SWINGS,
W69-05498 06B

LOUISIANA
TENNESSEE GAS TRANSMISSION CO V GREATER LAFOURCHE PORT COMMISSION (DAMAGE FOR FORCED LOWERING OF PIPELINE ACROSS NAVIGABLE STREAM).
W69-05541 06E

CLARK V GIFFORD-HILL AND CO (WATER POLLUTION BY MINING).
W69-05561 05G

CORNETT V HEBERT (OBSTRUCTION TO FLOW OF SURFACE WATER).
W69-05562 04A

DICKSON V BOARD OF COMM'RS OF CADDO LEVEE (EXPROPRIATION OF RIPARIAN LAND BY THE STATE).
W69-05585 06E

TALBOT V KERN (SERVITUDES OF DRAINAGE).
W69-05597 06E

BROWN V BLANKENSHIP (SUBSERVIENT DRAINAGE).
W69-05598 06E

LOW WATER MARK
MINIMUM AND MAXIMUM WATER-LEVEL RECORDING DEVICES,
W69-05250 07B

LUMBERING
TAKING OF WATERCRAFT, AIRCRAFT OR DRAFT ANIMALS INJURING OR CUTTING LOOSE BOOMS, RAFTS, VESSELS OR BOATS CIVIL ACTION FOR DAMAGES.
W69-05372 06E

LUSTRUMENTATION
STUDIES ON METHODS OF SOIL WATER DETERMINATION,
W69-05304 02G

MAINE
WETLANDS (CONTROL AND REGULATION IN MAINE).
W69-05366 06E

UNPROTECTED WELLS.
W69-05367 06E

REMOVAL OF BUSHES, TREES, AND STUMPS FROM FLOWED AREA.
W69-05368 04A

NUISANCES-MILLS AND DAMS FENCES AND BUILDINGS ON PUBLIC WAYS.
W69-05369 04A

DUMPING OF OIL.
W69-05370 05G

DAMAGE TO ICE.
W69-05371 06E

TAKING OF WATERCRAFT, AIRCRAFT OR DRAFT ANIMALS INJURING OR CUTTING LOOSE BOOMS, RAFTS, VESSELS OR BOATS CIVIL ACTION FOR DAMAGES.
W69-05372 06E

MALICIOUS MISCHIEFS-PUBLIC UTILITIES.
W69-05374 04C

NOTICE OF PETITIONS FOR SPECIAL LEGISLATION PERTAINING TO FISH AND GAME.
W69-05375 06E

SALT WATER ISLANDS.
W69-05565 06E

TRESPASS - IMPROVED LANDS AND FISH PONDS.
W69-05566 06E

MANOMETERS
WATER-MANOMETER-AIR-LINE ASSEMBLY FOR DETERMINING DEPTH TO WATER IN WELLS,
W69-05249 07B

MARGINAL COST PRICING
STATEMENT,
W69-05497 06C

MARGINAL PRODUCT
THE ESTIMATION OF MARGINAL PRODUCT FROM A COBB-DOUGLAS PRODUCTION FUNCTION,
W69-05521 06B

MARGINAL PRODUCTIVITY
THE ESTIMATION OF MARGINAL PRODUCT FROM A COBB-DOUGLAS PRODUCTION FUNCTION,
W69-05521 06B

MARKOV PROCESSES
RECURRENCE INTERVALS BETWEEN EXCEEDANCES OF SELECTED RIVER LEVELS. 2. ALTERNATIVES TO A MARKOV MODEL,
W69-05454 02E

MARYLAND
COUNTY COMMISSIONERS OF BALTIMORE COUNTY V HUNTER (DRAINAGE EASEMENT NUISANCE).
W69-05400 04A

BIBERMAN V FUNKHOUSER (UPPER LANDOWNER'S RIGHT TO HAVE SURFACE WATER DRAIN UPON LOWER LANDOWNER).
W69-05570 06E

STATE ROADS COMMISSION V BERRY (CONDEMNATION AWARDS).
W69-05596 06E

MASSACHUSETTS
COHASSET WATER CO V TOWN OF COHASSET (CONVEYANCE OF WATER WORKS TO TOWN).
W69-05583 06E

GOLDEN V AMORY (LIABILITY FOR FLOODING).
W69-05590 06E

MATHEMATICAL MODELS
PROBLEMS OF THE METHODS AND ACCURACY OF HYDROLOGIC OBSERVATIONS (RUSSIAN),
W69-05210 07A

PREDICTION OF SEDIMENT PROFILES IN OPEN CHANNEL FLOW BY TURBULENT DIFFUSION THEORY,
W69-05403 02J

TRANSIENT FLOW OF GROUND WATER TO WELLS IN MULTIPLE-AQUIFER SYSTEMS,
W69-05413 02F

RAINFALL-RUNOFF MODEL FOR SMALL BASIN FLOOD HYDROGRAPH SIMULATION,
W69-05420 02A

COMPUTER METHODS FOR TRANSIENT ANALYSIS OF WATER-TABLE AQUIFERS,
W69-05435 07C

RUNOFF HYDROGRAPH AS A FUNCTION OF RAINFALL EXCESS,
W69-05438 02A

COMPUTER EXPERIMENTS WITH FRACTIONAL GAUSSIAN NOISES, PARTS 1, 2, AND 3,
W69-05453 07C

RECURRENCE INTERVALS BETWEEN EXCEEDANCES OF SELECTED RIVER LEVELS. 2. ALTERNATIVES TO A MARKOV MODEL,
W69-05454 02E

MATHEMATICAL STUDIES
PROBLEMS OF THE METHODS AND ACCURACY OF HYDROLOGIC OBSERVATIONS (RUSSIAN),
W69-05210 07A

TRANSIENT FLOW OF GROUND WATER TO WELLS IN MULTIPLE-AQUIFER SYSTEMS,
W69-05413 02F

MEASUREMENT
ISOPIESTIC TECHNIQUE FOR MEASURING LEAF WATER POTENTIALS WITH A THERMOCOUPLE PSYCHROMETER,
W69-05286 02I

METHODOLOGY
PROBLEMS OF THE METHODS AND ACCURACY OF HYDROLOGIC OBSERVATIONS (RUSSIAN),
W69-05210 07A

CONCEPTUAL ISSUES IN THE CONDUCT OF REGIONAL RESEARCH ON THE ECONOMICS OF WATER,
W69-05480 06B

REGIONAL AND NATIONAL PLANNING OF AGRICULTURAL RESEARCH,
W69-05482 06B

MEXICO
NUCLEAR POWER AND WATER DESALTING PLANTS FOR SOUTHWEST UNITED STATES AND NORTHWEST MEXICO.
W69-05208 03A

MICHIGAN
UNWHOLESOME PREMISES REMOVAL AND REHABILITATION AT OWNER'S EXPENSE.
W69-05376 05B

HARBORS, WHARVES, AND HARBOR MASTERS.
W69-05377 04A

HIGHWAYS.
W69-05378 04C

W69-05379 04C

BURT V MUNGER (EROSION CONTROL AND LANDFILL BY RIPARIAN OWNER).
W69-05391 04A

HOLDA V PITTSBURGH FORGINGS CO (LANDFILLS AND OWNERSHIP OF BEDS).
W69-05398 06E

NAVIGABLE STREAMS, PERMISSION TO BRIDGE OR DAM PUBLIC SERVICE FACILITIES NATURAL RESOURCES.
W69-05564 06E

JONES V LUCAS (SURFACE DRAINAGE).
W69-05594 04A

MICOORGANISMS
THE MICROBIAL FLORA OF ACID MINE WATER AND ITS RELATIONSHIP TO FORMATION AND REMOVAL OF ACID,
W69-05314 05G

MICROCRUSTACEANS
LIMNOLOGICAL STUDIES OF LENTIC WATERS,
W69-05302 02H

MID-RANGES
AUTOCORRELATION BETWEEN FIRST DIFFERENCES OF MID-RANGES,
W69-05520 06B

MILL DAMS
NUISANCES-MILLS AND DAMS FENCES AND BUILDINGS ON PUBLIC WAYS.
W69-05369 04A

MINERALS
OFFSHORE PROSPECTING AND MINING LAWS OF THE UNITED STATES,
W69-05340 06E

MINING
OFFSHORE PROSPECTING AND MINING LAWS OF THE UNITED STATES,
W69-05340 06E

CLARK V GIFFORD-HILL AND CO (WATER POLLUTION BY MINING).
W69-05561 05G

MINNESOTA
ENDERSON V KELEHAM (UPLAND DRAINAGE OF SURFACE WATERS).
W69-05390 04A

STATE V BOLLENBACK (NAVIGABILITY OF LAKE).
W69-05576 06E

OSTLUND V STEARNS COUNTY (ARTIFICIAL ACCUMULATION OF SURFACE WATERS).
W69-05577 06E

MISSISSIPPI
MASONITE CORPORATION V GUY (FISHKILL EFFECTS OF WATER POLLUTION).
W69-05553 05C

HUTCHESON V SUNRALL (WATER SUPPLY EASEMENT).
W69-05599 06E

MISSISSIPPI RIVER
UNITED STATES V KANSAS CITY LIFE INSURANCE CO (FLOODING, UNDERFLOWING).
W69-05572 04A

MISSOURI
COMPREHENSIVE BASIN STUDY ON WHITE RIVER BASIN, ARKANSAS AND MISSOURI.
W69-05201 06B

CITY OF HARDIN V NORBORNE LAND DRAINAGE DISTRICT (STATUTORY RIGHTS TO MAINTAIN EXISTING LEVEES).
W69-05384 04A

TANEY COUNTY V EMPIRE DIST ELECTRIC CO (FLOOD DAMAGE AND CLAIM SETTLEMENT FOR FUTURE DAMAGES).
W69-05571 06E

UNITED STATES V KANSAS CITY LIFE INSURANCE CO (FLOODING, UNDERFLOWING).
W69-05572 04A

MIXING
ARTIFICIAL MIXING OF DENSITY-STRATIFIED FLUIDS A LABORATORY INVESTIGATION,
W69-05412 02H

MODEL STUDIES
DESIGN CRITERIA FOR LABORATORY CATCHMENT EXPERIMENTS, WITH PARTICULAR REFERENCE TO RAINFALL SIMULATION,
W69-05234 02A

A METHOD OF DETERMINING EVAPOTRANSPIRATION IN SOIL MONOLITHS,
W69-05270 02D

MOISTURE CONTENT
SOIL MOISTURE CONDITIONS UNDER PASTURES OF COOL-SEASON AND WARM-SEASON GRASSES,
W69-05266 02G

MOISTURE-RETENTION CAPACITY OF LITTER UNDER TWO ARIZONA CHAPARRAL COMMUNITIES,
W69-05267 02G

TISSUE WATER RELATIONS FOR BRIGALOW AND MULGA,
W69-05281 02I

STUDIES ON METHODS OF SOIL WATER DETERMINATION,
W69-05304 02G

SEASONAL AND DIURNAL VARIATION IN POCOSIN SHRUB MOISTURE CONTENT,
W69-05331 02I

MOISTURE DEFICIT
EFFECT OF MOISTURE REGIMES AND HARVESTS ON EFFICIENCY OF WATER USE BY TEN FORAGE CROPS,
W69-05268 02I

MOISTURE STRESS
DROUGHT AND PHOSPHORUS AFFECT GROWTH OF ANNUAL FORAGE LEGUMES,
W69-05264 02I

MEASUREMENT OF DROUGHT RESISTANCE IN CROP PLANTS,
W69-05265 02G

MONEY
MONEY, MULTIPLIER ACCELERATOR INTERACTION AND THE BUSINESS CYCLE,
W69-05291 06B

MONOLITHS
A METHOD OF DETERMINING EVAPOTRANSPIRATION IN SOIL MONOLITHS,
W69-05270 02D

MONSOONS
MEASUREMENT OF DROUGHT RESISTANCE IN CROP PLANTS,
W69-05265 02G

MOORING
MOORING AND FASTENING BOATS UPON RIPARIAN LANDS.
W69-05357 06E

MOUNTAIN LAKES
LIMNOLOGICAL STUDIES OF LENTIC WATERS,
W69-05302 02H

MOUNTAINS
MOUNTAIN RIVER FLOOD RUNOFF THEORY, MEANS OF ITS

INVESTIGATION AND CALCULATION,
W69-05230 02A

NUMERICAL FORECASTING OF MOUNTAIN RIVER FLOOD RUNOFF ON THE BASIS OF ESTABLISHING TERRITORIALLY - GENERALIZED RELATIONSHIPS,
W69-05231 02A

THE ASSESSMENT OF RUNOFF FROM A MOUNTAINOUS AND SEMI-ARID AREA IN WESTERN IRAN,
W69-05233 02E

MULGA
TISSUE WATER RELATIONS FOR BRIGALOW AND MULGA,
W69-05281 02I

MULTICOLLINEARITY
FACTOR ANALYSIS AND REGRESSION,
W69-05517 06B

MULTIDISCIPLINARY RESEARCH
CONCEPTUAL ISSUES IN THE CONDUCT OF REGIONAL RESEARCH ON THE ECONOMICS OF WATER,
W69-05480 06B

MULTIPLE EQUATION SYSTEMS
AN ALTERNATIVE PROOF OF HANNAN'S THEOREM ON CANONICAL CORRELATION AND MULTIPLE EQUATION SYSTEMS,
W69-05511 06D

MULTIPLE-PURPOSE PROJECTS
COMPREHENSIVE BASIN STUDY ON WHITE RIVER BASIN, ARKANSAS AND MISSOURI.
W69-05201 06B

THE FUNDAMENTAL ROLE OF WATER IN THE 'CASSA PER IL MEZZOGIORNO' DEVELOPMENT PROGRAMS FOR SOUTHERN ITALY,
W69-05216 06D

MUNICIPAL WASTES
PROCEEDINGS-SYMPOSIUM ON BETTER WATER AND SEWER SERVICES FOR SMALL COMMUNITIES IN NORTH CAROLINA.
W69-05312 03D

MUNICIPAL WATER
PROCEEDINGS-SYMPOSIUM ON BETTER WATER AND SEWER SERVICES FOR SMALL COMMUNITIES IN NORTH CAROLINA.
W69-05312 03D

NATURAL FLOW
LAWRENCE V EASTERN AIRLINES (DIVERSION OF NATURAL FLOW).
W69-05546 04A

BOBO V YOUNG (ARTIFICIAL DRAINAGE OF SURFACE WATERS AND NATURAL FLOW).
W69-05551 04A

BIBERMAN V FUNKHOUSER (UPPER LANDOWNER'S RIGHT TO HAVE SURFACE WATER DRAIN UPON LOWER LANDOWNER).
W69-05570 06E

LEWALLEN V DAVENPORT (DAMAGE FROM BACKING SURFACE RUNOFF).
W69-05600 04A

NATURAL FLOW DOCTRINE
BOAT V VAN VEEN (INTERFERENCE WITH WATER FLOW).
W69-05395 04A

WATER RESOURCES LAWS IN VIRGINIA (NATURAL SURFACE WATERCOURSES).
W69-05534 06E

NATURAL SEAWATER
BASIC STUDIES OF SCALE CONTROL,
W69-05334 03A

NATURAL STREAMS
TURNER V SMITH (RESERVOIR OBSTRUCTING LAND DRAINAGE).
W69-05392 04A

DODD V BLEZEK (DETERMINATION OF DOMINANT ESTATE AND DRAINAGE RIGHTS IN NATURAL STREAM).
W69-05393 04A

WATER RESOURCES LAW IN VIRGINIA.
W69-05533 06E

WATER RESOURCES LAWS IN VIRGINIA (NATURAL SURFACE WATERCOURSES).
W69-05534 06E

GWINN V MYERS (SUIT TO REMOVE OBSTRUCTION TO NATURAL WATERCOURSE).
W69-05557 04A

NAVIGABLE WATERS
ESTABLISHMENT OF STATE CONTROL OVER SUBMERGED LANDS.
W69-05347 06E

MOORING WATERCRAFT TO BUOYS OR BEACONS.
W69-05373 06E

TENNESSEE GAS TRANSMISSION CO V GREATER LAFOURCHE PORT COMMISSION (DAMAGE FOR FORCED LOWERING OF PIPELINE ACROSS NAVIGABLE STREAM).
W69-05541 06E

NAVIGABLE STREAMS, PERMISSION TO BRIDGE OR DAM PUBLIC SERVICE FACILITIES NATURAL RESOURCES.
W69-05564 06E

MUENCH V PUBLIC SERVICE COMMISSION (PUBLIC RIGHTS IN NAVIGABLE RIVER).
W69-05582 06E

NAVIGATION
REMOVAL OF BUSHES, TREES, AND STUMPS FROM FLOWED AREA.
W69-05368 04A

BROAD SCOPE OF NAVIGATION'S ECONOMIC IMPACT,
W69-05449 06B

MARINE AIR WAYS, INC V STATE (INTERFERENCE WITH NAVIGATION).
W69-05579 06E

NEGLIGENCE
COATES V UNITED STATES (TAKING OF PROPERTY FOR PUBLIC PURPOSE WITHOUT JUST COMPENSATION).
W69-05554 04A

NET WORTH
AN INCOME-NET WORTH APPROACH TO MEASURING ECONOMIC WELFARE,
W69-05290 06B

NEVADA
WATER-RESOURCES APPRAISAL OF THE SNAKE RIVER BASIN IN NEVADA,
W69-05414 02E

NEW HAMPSHIRE
POIRE V SERRA (PROPRIETY OF LAND FILL BY RIPARIAN OWNER).
W69-05381 04A

NEW JERSEY
RIPARIAN LANDS.
W69-05346 06E

ESTABLISHMENT OF STATE CONTROL OVER SUBMERGED LANDS.
W69-05347 06E

CONVEYANCES OF LANDS BY LEGISLATIVE AUTHORITY.
W69-05348 06E

TRESPASS ON LANDS OF STATE UNDERWATER AND CONVEYANCES BY COMMERCE AND NAVIGATION.
W69-05349 06E

SURVEY OPERATIONS AND CONTROLS BY THE BOARD OVER SUBMERGED LANDS.
W69-05350 06E

USAGE OF SUBMERGED LAND LEASE AND GRANT CONDITIONS AND PROCEDURE.
W69-05351 06E

PROTECTION OF THE PALISADES.
W69-05352 06E

GRANTS OF SUBMERGED LANDS TO THE STATE, MUNICIPALITIES, AND OTHER SUBDIVISIONS.
W69-05353 06E

ERRONEOUS GRANTS OF SUBMERGED LAND.
W69-05355 06E

DELINQUENT RIPARIAN LEASES RE-ENTRY BY THE STATE.
W69-05356 06E

MOORING AND FASTENING BOATS UPON RIPARIAN LANDS.
W69-05357 06E

STATE ACQUISITION OF RIPARIAN LANDS LEASE FOR COMMERCIAL ENTERPRISES.
W69-05358 06E

MORRIS CANAL AND BANKING COMPANY.
W69-05359 06E

W69-05360 06E

DELAWARE AND RARITAN CANAL.
W69-05361 04A

DRAINAGE AND FLOWAGE OF LANDS.
W69-05362 04A

WATERWAYS AND WATER FRONTS.
W69-05364 04A

PUBLIC PARKS - PLAYGROUNDS SALE OF RECLAIMED LANDS ABUTTING PARK LANDS.
W69-05365 06E

PENN CENTRAL CO V BUCKLEY AND CO (BRIDGE COLLISIONS SUIT).
W69-05380 06E

NEW YORK
WATERS OF WHITE LAKE INC V FRICKE (OWNERSHIP OF LAKE BEDS).
W69-05383 06E

TRUSTEES OF FREEHOLDERS AND COMMONALTY V MORRISEY (TITLE TO BEDS UNDER TIDAL WATERS).
W69-05388 06E

LOCH SHELDRAKE ASSOCIATES V EVANS (RESTRICTIVE CLAUSE ON THE USES OF WATER).
W69-05548 06E

TOWN OF VIENNA V STATE (PRESCRIPTIVE RIGHTS DOCTRINE AS APPLIED TO PUBLIC PROPERTY).
W69-05549 04A

REESE V STATE (DAMAGE TO LAND DUE TO DIVERSION OF STREAM).
W69-05560 04A

DILLENBECK V STATE (COMPENSATION FOR PERPETUAL EASEMENT TO FLOOD LAND).
W69-05573 06E

MARINE AIR WAYS, INC V STATE (INTERFERENCE WITH NAVIGATION).
W69-05579 06E

CRANCE V STATE (DAMAGES FOR APPROPRIATION OF RIPARIAN RIGHTS BY THE STATE).
W69-05580 06E

IN RE SITE FOR HUNTS POINT SEWAGE TREATMENT WORKS, BOROUGH OF BRONX, CITY OF NEW YORK (OWNERSHIP OF LAND UNDER WATER).
W69-05581 06E

IODICE V STATE (DUTIES OF DAM OWNERS).
W69-05589 06E

BLACK RIVER REGULATING DIST. V ADIRONDACK LEAGUE CLUB (CONDEMNATION PROCEEDINGS).
W69-05591 06E

TAYLOR V STATE (PRESCRIPTIVE RIGHT TO FLOOD LAND).
W69-05592 06E

NEW YORK STATE BARGE CANAL
TAYLOR V STATE (PRESCRIPTIVE RIGHT TO FLOOD LAND).
W69-05592 06E

NITRATES
EFFECT OF EARLY-SUMMER SEEDING OF WINTER WHEAT ON YIELD, SOIL MOISTURE, AND SOIL NITRATE,
W69-05280 03F

NITROGEN CYCLE IN SURFACE AND SUBSURFACE WATERS,
W69-05323 05B

NITRIFICATION
NITROGEN CYCLE IN SURFACE AND SUBSURFACE WATERS,
W69-05323 05B

NITROGEN
EFFECTS OF MOISTURE AND FERTILIZER ON YIELDS OF SPRING WHEAT AND BARLEY,
W69-05263 02I

NITROGEN CYCLE
NITROGEN CYCLE IN SURFACE AND SUBSURFACE WATERS,
W69-05323 05B

NONMARGINAL ECONOMICS
WATER RESOURCE DEVELOPMENT PUBLIC AND PRIVATE INVESTMENT,
W69-05486 06B

NON-NAVIGABLE WATERS
NUISANCES-MILLS AND DAMS FENCES AND BUILDINGS ON PUBLIC WAYS.
W69-05369 04A

STATE V BOLLENBACK (NAVIGABILITY OF LAKE).
W69-05576 06E

NORTH CAROLINA
PROCEEDINGS-SYMPOSIUM ON BETTER WATER AND SEWER SERVICES FOR SMALL COMMUNITIES IN NORTH CAROLINA.
W69-05312 03D

JOHNSON V CITY OF WINSTON-SALEM (ACTION FOR DAMAGES CAUSED BY AN OBSTRUCTED DRAIN PIPE).
W69-05394 04A

STATE V GLIDDEN CO (CONSTITUTIONALITY OF WATER POLLUTIONS CONTROL STATUTE).
W69-05586 05G

NORTH CENTRAL REGION RESEARCH PROJECT NC-57
REGIONAL RESEARCH IN WATER IN THE NORTH CENTRAL REGION,
W69-05478 06B

NORTHEASTERN TROPICAL PACIFIC
EFFECTS OF PHOSPHATE CONCENTRATION ON CELL DIVISION RATES AND YIELD OF A TROPICAL OCEANIC DIATOM,
W69-05530 05C

NOTICE
NOTICE OF PETITIONS FOR SPECIAL LEGISLATION PERTAINING TO FISH AND GAME.
W69-05375 06E

NUCLEAR POWERPLANTS
NUCLEAR POWER AND WATER DESALTING PLANTS FOR SOUTHWEST UNITED STATES AND NORTHWEST MEXICO.
W69-05208 03A

NUISANCE
LAWRENCE V EASTERN AIRLINES (DIVERSION OF NATURAL FLOW).
W69-05546 04A

OBSERVATION WELLS
MINIMUM AND MAXIMUM WATER-LEVEL RECORDING DEVICES,
W69-05250 07B

OBSTRUCTION TO FLOW
TURNER V SMITH (RESERVOIR OBSTRUCTING LAND DRAINAGE).
W69-05392 04A

DODD V BLEZEK (DETERMINATION OF DOMINANT ESTATE AND DRAINAGE RIGHTS IN NATURAL STREAM).
W69-05393 04A

JOHNSON V CITY OF WINSTON-SALEM (ACTION FOR DAMAGES CAUSED BY AN OBSTRUCTED DRAIN PIPE).
W69-05394 04A

DESTEFANO V MEGLIO (DAMAGES FOR OBSTRUCTION OF A DRAIN).
W69-05543 06E

MORRIS V WINTERS (ACTION TO REMOVE AN OBSTRUCTION TO WATER FLOW).
W69-05567 04A

TALBOT V KERN (SERVITUDES OF DRAINAGE).
W69-05597 06E

BROWN V BLANKENSHIP (SUBSERVIENT DRAINAGE).
W69-05598 06E

OCTADECANOL
EFFECT OF FATTY ALCOHOL ON CHANGE IN SOIL WATER DURING THE SUMMER FALLOW PERIOD,
W69-05284 02G

OHIO
SOURCES OF COAL MINE DRAINAGE POLLUTION, WHEELING CREEK WATERSHED, OHIO.
W69-05202 05B

STATE SQUIRE V CITY OF CLEVELAND (FILL LAND AND HIGHWAY USE AS TO LITTORAL RIGHTS).
W69-05555 04C

OIL SPILLS
OIL SPILLAGE STUDY, LITERATURE SEARCH, AND CRITICAL EVALUATION FOR SELECTION OF PROMISING TECHNIQUES TO CONTROL AND PREVENT DAMAGE,
W69-05262 05G

OIL WASTES
DUMPING OF OIL.
W69-05370 05G

OILY WATER
OIL SPILLAGE STUDY, LITERATURE SEARCH, AND CRITICAL EVALUATION FOR SELECTION OF PROMISING TECHNIQUES TO CONTROL AND PREVENT DAMAGE,
W69-05262 05G

IDENTIFICATION AND DIFFERENTIATION OF HEAVY RESIDUAL OIL AND ASPHALT POLLUTANTS IN SURFACE WATERS BY COMPARATIVE RATIOS OF INFRARED ABSORBANCES,
W69-05421 05A

OLIGOTROPHY
LIMNOLOGICAL STUDIES OF LENTIC WATERS,
W69-05302 02H

OPERATION AND MAINTENANCE
USE OF CARBON DIOXIDE IN BUBBLE GAGES TO PREVENT PRECIPITATION OF CALCIUM CARBONATE,
W69-05247 07B

POLYETHYLENE OIL TUBES FOR STILLING WELLS,
W69-05248 07B

MORRIS CANAL AND BANKING COMPANY.
W69-05360 06E

OPPORTUNITY COSTS
WATER ALLOCATION SUPPLY AND DEMAND RELATIONSHIPS,
W69-05483 06B

OPTIMIZATION METHODS
A COMMENT ON OPTIMIZATION METHODS FOR BRANCHING MULTISTAGE WATER RESOURCE SYSTEMS,
W69-05499 06A

OPTIMIZATION METHODS FOR BRANCHING MULTISTAGE WATER RESOURCE SYSTEMS--A REPLY TO A COMMENT BY E. F. BRATER,
W69-05501 06A

OPTIMUM DEVELOPMENT PLANS
THE ORGANIZATION OF VENEZUELA FOR THE UTILIZATION OF ITS WATER RESOURCES (SPANISH),
W69-05220 06E

WATER RESOURCES OF THE BURNETT REGION,
W69-05423 02E

ORGANOCHLORIDE INSECTICIDES
DETERMINATION OF ORGANOCHLORINE INSECTICIDES IN SOILS AND WATERS,
W69-05325 05A

OSMOTIC PRESSURE
MOVEMENT OF WATER AND SALT THROUGH A CLAY-WATER SYSTEM EXPERIMENTAL VERIFICATION OF ONSAGER RECIPROCAL RELATION,
W69-05441 02G

THE EFFECT OF OSMOTIC PRESSURE GRADIENTS ON WATER MOVEMENT IN UNSATURATED SOIL,
W69-05442 02G

OVERFLOW
GARGAC V SMITH-ROWLAND CO (POLLUTION OF LAKE BY INDUSTRIAL WASTES).
W69-05387 05C

CLARK V GIFFORD-HILL AND CO (WATER POLLUTION BY MINING).
W69-05561 05G

DILLENBECK V STATE (COMPENSATION FOR PERPETUAL EASEMENT TO FLOOD LAND).
W69-05573 06E

EAVES V CITY OF OTTUMWA (LIABILITY FOR FLOOD DAMAGE).
W69-05587 06E

IODICE V STATE (DUTIES OF DAM OWNERS).
W69-05589 06E

GOLDEN V AMORY (LIABILITY FOR FLOODING).
W69-05590 06E

OVERLAND FLOW
ENDERSON V KELEHAN (UPLAND DRAINAGE OF SURFACE WATERS).
W69-05390 04A

OWNERSHIP OF BEDS
RIPARIAN LANDS.
W69-05346 06E

CONVEYANCES OF LANDS BY LEGISLATIVE AUTHORITY.
W69-05348 06E

SURVEY OPERATIONS AND CONTROLS BY THE BOARD OVER SUBMERGED LANDS.
W69-05350 06E

CONFIRMATORY LEASES AND GRANTS OF SUBMERGED LAND.
W69-05354 06E

WATERS OF WHITE LAKE INC V FRICKE (OWNERSHIP OF LAKE BEDS).
W69-05383 06E

TRUSTEES OF FREEHOLDERS AND COMMONALTY V MORRISEY (TITLE TO BEDS UNDER TIDAL WATERS).
W69-05388 06E

HURT V MUNGER (EROSION CONTROL AND LANDFILL BY RIPARIAN OWNER).
W69-05391 04A

HOLDA V PITTSBURGH FORGINGS CO (LANDFILLS AND OWNERSHIP OF BEDS).
W69-05398 06E

WATER RESOURCES LAWS IN VIRGINIA (NATURAL SURFACE WATERCOURSES).
W69-05534 06E

IN RE SITE FOR HUNTS POINT SEWAGE TREATMENT WORKS, BOROUGH OF BRONX, CITY OF NEW YORK (OWNERSHIP OF LAND UNDER WATER).
W69-05581 06E

PALISADES
PROTECTION OF THE PALISADES.
W69-05352 06E

PALMER DROUGHT INDEX
RELATIONSHIP OF PALMER DROUGHT VARIABLES TO YIELD OF WINTER WHEAT,
W69-05283 03F

PARAMETERS
IDENTIFICATION OF NONLINEAR PARAMETERS OF GROUND WATER BASINS BY HYBRID COMPUTATION,
W69-05271 02F

PARAMETRIC HYDROLOGY
IDENTIFICATION OF NONLINEAR PARAMETERS OF GROUND WATER BASINS BY HYBRID COMPUTATION,
W69-05271 02F

PARTICLE SIZE
A CONTINUOUS SIZE SPECTRUM FOR PARTICULATE MATTER IN THE SEA,
W69-05529 07C

PARTICULATE MATTER
A CONTINUOUS SIZE SPECTRUM FOR PARTICULATE MATTER IN THE SEA,
W69-05529 07C

PASTURES
SOIL MOISTURE CONDITIONS UNDER PASTORES OF COOL-SEASON AND WARM-SEASON GRASSES,
W69-05266 02G

PATH OF POLLUTANTS
THE LONGITUDINAL DIFFUSION COEFFICIENT IN THE DELAWARE RIVER ESTUARY AS DETERMINED FROM A STEADY-STATE MODEL,
W69-05428 02L

PEAS
STUDIES ON WATER USE IN PEA (PISUM SATIVUM L.),
W69-05287 03F

PENNSYLVANIA
LUCAS V FORD (EASEMENT - SURFACE WATER DRAINAGE).
W69-05397 04A

RAU V WILDEN ACRES, INC (ACCUMULATION-RIPDANCE).
W69-05544 04A

MORRIS V WINTERS (ACTION TO REMOVE AN OBSTRUCTION TO WATER FLOW).
W69-05567 04A

LEIPER V HEYWOOD-HALL CONSTR CO (CLAIM OF ARTIFICIALLY INCREASED DRAINAGE ON PART OF UPPER LANDOWNER).
W69-05568 06E

CARLSON V A AND P CORRUGATED BOX CORP (FLOODING CAUSED BY NEGLIGENT MAINTENANCE OF DAM).
W69-05588 04A

PERCOLATING WATER
WATER RESOURCES LAW IN VIRGINIA.
W69-05533 06E

WATER RESOURCES LAWS IN VIRGINIA (PERCOLATING GROUNDWATER - DIFFUSED SURFACE WATER).
W69-05535 06E

PERCOLATION
UNITED STATES V KANSAS CITY LIFE INSURANCE CO (FLOODING, UNDERFLOWING).
W69-05572 04A

PERMAFROST
STUDIES OF RUNOFF FORMATION UNDER CONDITION OF HIGH-ANGLE ATTITUDE OF THE IMPERVIOUS BED,
W69-05229 02E

PERMEABILITY
PORE SIZE DISTRIBUTIONS AS MEASURED BY THE MERCURY INTRUSION METHOD AND THEIR USE IN PREDICTING PERMEABILITY,
W69-05439 02G

DETERMINING THE RATIO OF HORIZONTAL TO VERTICAL PERMEABILITY BY AQUIFER-TEST ANALYSIS,
W69-05452 02F

PERMITS
WETLANDS (CONTROL AND REGULATION IN MAINE).
W69-05366 06E

WATER RESOURCES LAWS IN VIRGINIA (REMEDIES FOR INFRINGEMENT OF WATER RIGHTS).
W69-05538 06E

PESTICIDE RESIDUES
PESTICIDES NOT ENOUGH KNOWN.
W69-05215 05G

PESTICIDE LEVELS AND FLUCTUATION IN SOIL BACTERIA IN AN IRRIGATED FIELD AND A POND OF SOUTHWEST TEXAS,
W69-05272 05C

PESTICIDES
PESTICIDES NOT ENOUGH KNOWN.
W69-05215 05G

PETROLEUM PRODUCTS
IDENTIFICATION AND DIFFERENTIATION OF HEAVY RESIDUAL OIL AND ASPHALT POLLUTANTS IN SURFACE WATERS BY COMPARATIVE RATIOS OF INFRARED ABSORBANCES,
W69-05421 05A

PHENOLS
TREATING COKE PLANT WASTE,
W69-05422 05D

PHOSPHATES
EFFECTS OF PHOSPHATE CONCENTRATION ON CELL DIVISION RATES AND YIELD OF A TROPICAL OCEANIC DIATOM,
W69-05530 05C

PHOSPHORUS
DROUGHT AND PHOSPHORUS AFFECT GROWTH OF ANNUAL FORAGE LEGUMES,
W69-05264 02I

RESERVOIR MANAGEMENT PROBLEMS CREATED BY INCREASED PHOSPHORUS LEVELS OF SURFACE WATERS,
W69-05470 02H

PHOSPHORUS COMPOUNDS
PHOSPHORUS IN FLOWING WATERS,
W69-05445 05B

PHOSPHORUS RADIOISOTOPES
ACCUMULATION OF PHOSPHORUS-32 AND ZINC-65 BY LIVING AND KILLED PLANKTON,
W69-05531 05C

PHOTOGRAPHY
DYE-CLOUD PHOTOGRAPHY,
W69-05241 07B

PHYLLODES
TISSUE WATER RELATIONS FOR BRIGALOW AND MULGA,
W69-05281 02I

PHYSICOCHEMISTRY
DYNAMICS OF PHYSICOCHEMISTRY IN A LARGE RESERVOIR,
W69-05466 02H

PHYTOPLANKTON
BIOLOGICAL ASPECTS OF EUTROPHICATION IN LAKES MENDOTA, CRYSTAL, TROUT AND GREEN,
W69-05324 02H

PILOT PLANTS
A PILOT PLANT STUDY FOR REMOVAL OF SOLUBLE SILICA FROM ROSWELL, NEW MEXICO WATER. PHASE 1. INITIAL CONSTRUCTION AND OPERATION,
W69-05335 03A

PIPE FLOW
UNSTEADY FLOW PARAMETERS IN HYDRAULIC DESIGN,

W69-05408 08B

PISCATAQUA RIVER
ECONOMIC ANALYSIS OF PUBLIC WATER SUPPLY IN THE PISCATAQUA RIVER WATERSHED,
W69-05510 03E

PLANKTON
ACCUMULATION OF PHOSPHORUS-32 AND ZINC-65 BY LIVING AND KILLED PLANKTON,
W69-05531 05C

PLANNING
A STATE VIEWPOINT ON RIVER BASIN PLANNING,
W69-05209 06B

PROCEEDINGS OF SYMPOSIUM ON BETTER WATER AND SEWER SERVICES FOR SMALL COMMUNITIES IN NORTH CAROLINA,
W69-05424 06B

ECONOMIC ALTERNATIVES,
W69-05528 05G

PLANT MANAGEMENT
TILLAGE METHODS TO REDUCE RUNOFF AND EROSION IN THE CORN BELT,
W69-05330 03F

PLANT TISSUES
TISSUE WATER RELATIONS FOR BRIGALOW AND MULGA,
W69-05281 02I

ISOPIESTIC TECHNIQUE FOR MEASURING LEAF WATER POTENTIALS WITH A THERMOCOUPLE PSYCHROMETER,
W69-05286 02I

PLANTING MANAGEMENT
EFFECT OF EARLY-SUMMER SEEDING OF WINTER WHEAT ON YIELD, SOIL MOISTURE, AND SOIL NITRATE,
W69-05280 03F

PLAYAS
QUALITY OF WATERS FROM PLAYAS ON THE SOUTHERN HIGH PLAINS,
W69-05276 03C

POCOSIN
SEASONAL AND DIURNAL VARIATION IN POCOSIN SHRUB MOISTURE CONTENT,
W69-05331 02I

POLLUTANT IDENTIFICATION
DEVELOPMENT OF BIOLOGICAL INDICES TO POLLUTION LEVELS IN STREAMS AFFECTED BY ACID MINE DRAINAGE AND OIL FIELD BRINE WASTES,
W69-05407 05A

POLLUTION
WATER RESOURCES LAW IN VIRGINIA (OTHER WATER SOURCES).
W69-05536 06E

POLLUTION ABATEMENT
TENNESSEE VALLEY SAND AND GRAVEL CO V PILLING (LIABILITY FOR SEDIMENT DUMPING WHICH MAKES CREEK BED SHALLOWER, WHICH CAUSES MORE FLOODING).
W69-05386 05G

PONDS
PESTICIDE LEVELS AND FLUCTUATION IN SOIL BACTERIA IN AN IRRIGATED FIELD AND A POND OF SOUTHWEST TEXAS,
W69-05272 05C

HOLDA V PITTSBURGH FORGINGS CO (LANDFILLS AND OWNERSHIP OF BEDS).
W69-05398 06E

POROSITY
PORE SIZE DISTRIBUTIONS AS MEASURED BY THE MERCURY INTRUSION METHOD AND THEIR USE IN PREDICTING PERMEABILITY,
W69-05439 02G

HYDRAULIC CONDUCTIVITY RELATED TO POROSITY AND SWELLING OF SOIL,
W69-05443 02G

POROUS MEDIA
HYDRODYNAMIC DISPERSION IN A SATURATED HOMOGENEOUS POROUS MEDIUM AT LOW PECLET NUMBERS AND NONHOMOGENEOUS SOLUTION,
W69-05434 01B

PORE SIZE DISTRIBUTIONS AS MEASURED BY THE MERCURY INTRUSION METHOD AND THEIR USE IN PREDICTING PERMEABILITY,
W69-05439 02G

PORTLAND(MAINE)
HARBOR DEVELOPMENT PORT OF PORTLAND, MAINE.
W69-05298 06B

POTABLE WATER
PORTABLE WATER PURIFIERS FOR COSTA RICA,
W69-05456 05D

POWDER
EFFECT OF FATTY ALCOHOL ON CHANGE IN SOIL WATER DURING THE SUMMER FALLOW PERIOD,
W69-05284 02G

POWER SPECTRA
THE TYPICAL SPECTRAL SHAPE OF AN ECONOMIC VARIABLE,
W69-05522 06D

PRECIPITATION
PREPARATION OF CO-ORDINATED PRECIPITATION, RUNOFF AND EVAPORATION MAPS,
W69-05337 02A

PRECIPITATION EXCESS
CICONTE V SHOCKLEY (RUNOFF NUISANCE).
W69-05396 04A

PRESCRIPTIVE RIGHTS
DESTEFANO V MEGLIO (DAMAGES FOR OBSTRUCTION OF A DRAIN).
W69-05543 06E

TOWN OF VIENNA V STATE (PRESCRIPTIVE RIGHTS DOCTRINE AS APPLIED TO PUBLIC PROPERTY).
W69-05549 04A

TAYLOR V STATE (PRESCRIPTIVE RIGHT TO FLOOD LAND).
W69-05592 06E

PRICING
WATER ALLOCATION SUPPLY AND DEMAND RELATIONSHIPS,
W69-05483 06B

PROCEEDINGS WATER POLICY PRICING CONFERENCE,
W69-05492 06C

LEGAL CONSTRAINTS IN WATER PRICING POLICY,
W69-05493 06C

THE ACCOUNTANT'S VIEWPOINT ON WATER PRICING POLICY,
W69-05494 06C

THE CONSUMER'S VIEWPOINT AND POLICY DECISIONS,
W69-05495 06C

STATEMENT,
W69-05497 06C

ECONOMIC ANALYSIS OF PUBLIC WATER SUPPLY IN THE PISCATAQUA RIVER WATERSHED,
W69-05510 03E

PRIMARY PRODUCTIVITY
EFFECTS OF PHOSPHATE CONCENTRATION ON CELL DIVISION RATES AND YIELD OF A TROPICAL OCEANIC DIATOM,
W69-05530 05C

PROBABILITY
COMPUTER EXPERIMENTS WITH FRACTIONAL GAUSSIAN NOISES, PARTS 1, 2, AND 3,
W69-05453 07C

RECURRENCE INTERVALS BETWEEN EXCEEDANCES OF SELECTED RIVER LEVELS. 2. ALTERNATIVES TO A MARKOV MODEL,
W69-05454 02E

FREQUENCY CURVES FOR ANNUAL FLOOD SERIES WITH SOME ZERO EVENTS OR INCOMPLETE DATA,
W69-05455 07C

PRODUCTIVITY
BIOLOGICAL ASPECTS OF EUTROPHICATION IN LAKES MENDOTA, CRYSTAL, TROUT AND GREEN,
W69-05324 02H

PROJECT PLANNING
DELAWARE RIVER BASIN COMPACT.
W69-05343 04A

PROJECT PURPOSES
UNITED STATES V WILLIS (ARBITRARINESS IN LAND CONDEMNATION).
W69-05574 06E

PUBLIC BENEFITS
HARBOR DEVELOPMENT PORT OF PORTLAND, MAINE.
W69-05298 06B

PUBLIC HEALTH
WATER FOR LIVING,
W69-05219 05C

PUBLIC PURPOSES
TOWN OF VIENNA V STATE (PRESCRIPTIVE RIGHTS DOCTRINE AS APPLIED TO PUBLIC PROPERTY).
W69-05549 04A

PUBLIC RIGHTS
NUENCH V PUBLIC SERVICE COMMISSION (PUBLIC RIGHTS IN NAVIGABLE RIVER).
W69-05582 06E

PUBLIC UTILITIES
COHASSET WATER CO V TOWN OF COHASSET (CONVEYANCE OF WATER WORKS TO TOWN).
W69-05583 06E

PUBLIC WORKS
EARLY V SOUTH CAROLINA PUBLIC SERVICE AUTHORITY (CONSTRUCTION OF DAM AND DIVERSION OF RIVER).
W69-05578 04A

PUBLICATIONS
WRITING A WATER QUALITY REPORT,
W69-05212 10

PULP WASTES
COMPONENTS OF WOOD PULP BLEACH EFFLUENTS,
W69-05402 05A

PUMPING TESTS
WATER-MANOMETER-AIR-LINE ASSEMBLY FOR DETERMINING DEPTH TO

WATER IN WELLS,
W69-05249 07B

RABBITBUSH
SOIL PROBLEMS IN RESEEDING A GREASEWOOD-RABBITBRUSH RANGE SITE,
W69-05269 02G

RADIOACTIVE ACCUMULATION
ACCUMULATION OF PHOSPHORUS-32 AND ZINC-65 BY LIVING AND KILLED PLANKTON,
W69-05531 05C

RADIOACTIVE UPTAKE
ACCUMULATION OF PHOSPHORUS-32 AND ZINC-65 BY LIVING AND KILLED PLANKTON,
W69-05531 05C

RADIOECOLOGY
ACCUMULATION OF PHOSPHORUS-32 AND ZINC-65 BY LIVING AND KILLED PLANKTON,
W69-05531 05C

RAIN GAGES
WATER-STAGE AND RAINFALL DUAL RECORDER,
W69-05253 07B

AN ACCURATE SMALL ORIFICE RAIN GAGE,
W69-05404 07B

RAINFALL
EFFECTS OF MOISTURE AND FERTILIZER ON YIELDS OF SPRING WHEAT AND BARLEY,
W69-05263 02I

RAINFALL SIMULATORS
DESIGN CRITERIA FOR LABORATORY CATCHMENT EXPERIMENTS, WITH PARTICULAR REFERENCE TO RAINFALL SIMULATION,
W69-05234 02A

RAINFALL-RUNOFF RELATIONSHIPS
AN EXPERIMENTAL INVESTIGATION OF PARTIAL AREA CONTRIBUTIONS,
W69-05227 02A

STUDIES OF RUNOFF FORMATION UNDER CONDITION OF HIGH-ANGLE ATTITUDE OF THE IMPERVIOUS BED,
W69-05229 02E

MOUNTAIN RIVER FLOOD RUNOFF THEORY, MEANS OF ITS INVESTIGATION AND CALCULATION,
W69-05230 02A

NUMERICAL FORECASTING OF MOUNTAIN RIVER FLOOD RUNOFF ON THE BASIS OF ESTABLISHING TERRITORIALLY - GENERALIZED RELATIONSHIPS,
W69-05231 02A

THE ASSESSMENT OF SURFACE RUNOFF FROM RAINFALL DATA FOR AN ARID REGION OF WEST PAKISTAN,
W69-05232 02E

THE ASSESSMENT OF RUNOFF FROM A MOUNTAINOUS AND SEMI-ARID AREA IN WESTERN IRAN,
W69-05233 02E

DESIGN CRITERIA FOR LABORATORY CATCHMENT EXPERIMENTS, WITH PARTICULAR REFERENCE TO RAINFALL SIMULATION,
W69-05234 02A

RAINFALL-RUNOFF MODEL FOR SMALL BASIN FLOOD HYDROGRAPH SIMULATION,
W69-05420 02A

A PROPOSED MECHANICS FOR THE INVESTIGATION OF SURFACE RUNOFF FROM SMALL WATERSHEDS. 1, DEVELOPMENT,
W69-05425 02A

RUNOFF VOLUME PREDICTION FROM DAILY CLIMATIC DATA,
W69-05426 02A

USING ANALYTICAL METHODS TO DEVELOP A SURFACE-RUNOFF MODEL,
W69-05431 02A

RUNOFF HYDROGRAPH AS A FUNCTION OF RAINFALL EXCESS,
W69-05438 02A

RANGE MANAGEMENT
SOIL PROBLEMS IN RESEEDING A GREASEWOOD-RABBITBRUSH RANGE SITE,
W69-05269 02G

RATE LEVEL
LEGAL CONSTRAINTS IN WATER PRICING POLICY,
W69-05493 06C

RATE STRUCTURE
LEGAL CONSTRAINTS IN WATER PRICING POLICY,
W69-05493 06C

RATES OF APPLICATION
STUDIES ON WATER USE IN PEA (PISUM SATIVUM L.),
W69-05287 03F

RATING CURVES
CHARACTERISTICS OF LOGARITHMIC RATING CURVES,
W69-05259 07B

REAERATION
ARTIFICIAL MIXING OF DENSITY-STRATIFIED FLUIDS A LABORATORY INVESTIGATION,
W69-05412 02H

WATER QUALITY IN IMPOUNDMENTS AND MODIFICATIONS FROM DESTRATIFICATION,
W69-05467 02H

REAL PROPERTY
PROTECTION OF THE PALISADES.
W69-05352 06E

REASONABLE USE
BRAY V CITY OF WINTER GARDEN (SURFACE WATERS CAST ON LOWER PROPERTY).
W69-05563 04A

LEIPER V HEYWOOD-HALL CONSTR CO (CLAIM OF ARTIFICIALLY INCREASED DRAINAGE ON PART OF UPPER LANDOWNER).
W69-05568 06E

RECLAMATION
USAGE OF SUBMERGED LAND LEASE AND GRANT CONDITIONS AND PROCEDURE.
W69-05351 06E

REFRACTION(WATER WAVES)
WATER WAVES OVER A RECTANGULAR CHANNEL THROUGH A REEF,
W69-05448 02L

REGIONAL ANALYSIS
REGIONAL RESEARCH IN WATER IN THE NORTH CENTRAL REGION,
W69-05478 06B

DISCUSSION OF REGIONAL RESEARCH IN THE NORTH CENTRAL REGIO
W69-05479 06B

CONCEPTUAL ISSUES IN THE CONDUCT OF REGIONAL RESEARCH ON T ECONOMICS OF WATER,
W69-05480 06B

DISCUSSION OF CONCEPTUAL ISSUES IN THE CONDUCT OF REGIONAL RESEARCH ON THE ECONOMICS OF WATER,
W69-05481 06B

REGIONAL ECONOMIC DEVELOPMENT AND WATER,
W69-05488 06B

DISCUSSION OF REGIONAL ECONOMIC DEVELOPMENT AND WATER,
W69-05489 06B

REGIONAL GROWTH STAGES
REGIONAL ECONOMIC DEVELOPMENT AND WATER,
W69-05488 06B

REGRESSION ANALYSIS
LONG SWINGS,
W69-05498 06B

FACTOR ANALYSIS AND REGRESSION,
W69-05517 06B

REMEDIES
WATER RESOURCES LAWS IN VIRGINIA (REMEDIES FOR INFRINGEMEI OF WATER RIGHTS).
W69-05538 06E

REPULSION(LEGAL ASPECTS)
CITY OF HARDIN V MORBORNE LAND DRAINAGE DISTRICT (STATUTO RIGHTS TO MAINTAIN EXISTING LEVEES).
W69-05384 04A

CICONTE V SHOCKLEY (RUNOFF NUISANCE).
W69-05396 04A

LUCAS V FORD (EASEMENT - SURFACE WATER DRAINAGE).
W69-05397 04A

COUNTY COMMISSIONERS OF BALTIMORE COUNTY V HUNTER (DRAINA EASEMENT NUISANCE).
W69-05400 04A

RAU V WILDEN ACRES, INC (ACCUMULATION-RIDDANCE).
W69-05544 04A

DEYO V ATHOL HOUSING AUTHORITY (DAMAGE FROM WATER DISCHARGE).
W69-05556 04C

BROWN V BLANKENSHIP (SUBSERVIENT DRAINAGE).
W69-05598 06E

LEWALLEN V DAVENPORT (DAMAGE FROM BACKING SURFACE RUNOFF)
W69-05600 04A

REPULSION(LEGAL ASPECT)
NEWTON V LYONS (COMMON ENEMY EXCEPTION).
W69-05545 06E

RESEARCH AND DEVELOPMENT
WATER RESOURCES POLICY AND POLITICAL INSTITUTIONS.
W69-05295 06B

RESEARCH PROBLEMS
MAJOR RESEARCH PROBLEMS IN WATER QUALITY,
W69-05519 05G

RESERVOIR CONSTRUCTION
BLACK RIVER REGULATING DIST. V ADIRONDACK LEAGUE CLUB (CONDEMNATION PROCEEDINGS).
W69-05591 06E

RESERVOIR FISHERIES
RESERVOIR FISHERY RESOURCES

W69-05463 02H

RESERVOIR FISHERY MANAGEMENT
RESERVOIR FISHERY RESOURCES,
W69-05463 02H

RESERVOIR OPERATION
RESERVOIR MANAGEMENT PROBLEMS CREATED BY INCREASED PHOSPHORUS LEVELS OF SURFACE WATERS,
W69-05470 02H

UNITED STATES V WILLIS (ARBITRARINESS IN LAND CONDEMNATION).
W69-05574 06E

RESERVOIR STORAGE
PROBLEMS OF THE METHODS AND ACCURACY OF HYDROLOGIC OBSERVATIONS (RUSSIAN),
W69-05210 07A

RESERVOIRS
ARTIFICIAL MIXING OF DENSITY-STRATIFIED FLUIDS A LABORATORY INVESTIGATION,
W69-05412 02H

WATER QUALITY INVESTIGATION, PART 1 - BASIC DATA, FORT LOUDOUN RESERVOIR, APRIL 1966 - JUNE 1968,
W69-05416 05A

THE MECHANICS OF STRATIFIED FLOW IN RESERVOIRS,
W69-05464 02H

DYNAMICS OF PHYSICOCHEMISTRY IN A LARGE RESERVOIR,
W69-05466 02H

WATER QUALITY IN IMPOUNDMENTS AND MODIFICATIONS FROM DESTRATIFICATION,
W69-05467 02H

EVALUATION OF PRE-IMPOUNDMENT CONDITIONS FOR PREDICTION OF STORED WATER QUALITY,
W69-05468 02H

EFFECT OF IMPOUNDMENTS ON PRODUCTIVITY, WATER CHEMISTRY, AND HEAT BUDGETS OF RIVERS,
W69-05469 02H

RESERVOIR EUTROPHICATION AND DYSTROPHICATION FOLLOWING IMPOUNDMENT,
W69-05471 02H

RESOURCE ALLOCATION
WATER RESOURCE DEVELOPMENT PUBLIC AND PRIVATE INVESTMENT,
W69-05486 06B

RESOURCE DEVELOPMENT
WATER RESOURCE DEVELOPMENT PUBLIC AND PRIVATE INVESTMENT,
W69-05486 06B

DISCUSSION OF WATER RESOURCE DEVELOPMENT PUBLIC AND PRIVATE INVESTMENT,
W69-05487 06B

REGIONAL ECONOMIC DEVELOPMENT AND WATER,
W69-05488 06B

RETAINING WALLS
JOHNSON V RAY (RIGHT TO CONSTRUCT RETAINING WALL)
W69-05382 04A

BURT V MUNGER (EROSION CONTROL AND LANDFILL BY RIPARIAN OWNER).
W69-05391 04A

RETENTION
MOISTURE-RETENTION CAPACITY OF LITTER UNDER TWO ARIZONA CHAPARRAL COMMUNITIES,
W69-05267 02G

RETURN(MONETARY)
WATER RESOURCE DEVELOPMENT PUBLIC AND PRIVATE INVESTMENT,
W69-05486 06B

RHODE ISLAND
A STUDY OF THE EFFECT OF TAXATION ON THE SIX PRIVATE OR QUASI-MUNICIPAL WATER UTILITIES IN RHODE ISLAND,
W69-05316 06C

RIDDANCE(LEGAL ASPECTS)
CICONTE V SHOCKLEY (RUNOFF NUISANCE).
W69-05396 04A

LUCAS V FORD (EASEMENT - SURFACE WATER DRAINAGE).
W69-05397 04A

RAU V WILDEN ACRES, INC (ACCUMULATION-RIDDANCE).
W69-05544 04A

NEWTON V LYONS (COMMON ENEMY EXCEPTION).
W69-05545 06E

RIBERHAN V FUNKHOUSER (UPPER LANDOWNER'S RIGHT TO HAVE SURFACE WATER DRAIN UPON LOWER LANDOWNER).
W69-05570 06E

RIGHT OF WAY
COUNTY COMMISSIONERS OF BALTIMORE COUNTY V HUNTER (DRAINAGE EASEMENT NUISANCE).
W69-05400 04A

CHANCE V STATE (DAMAGES FOR APPROPRIATION OF RIPARIAN RIGHTS BY THE STATE).
W69-05580 06E

RIGHTS-OF-WAY
SURVEY OPERATIONS AND CONTROLS BY THE BOARD OVER SUBMERGED LANDS.
W69-05350 06E

RIPARIAN LAND
DICKSON V BOARD OF COMM'RS OF CADDO LEVEE (EXPROPRIATION OF RIPARIAN LAND BY THE STATE).
W69-05585 06E

RIPARIAN LANDS
RIPARIAN LANDS.
W69-05346 06E

TRESPASS ON LANDS OF STATE UNDERWATER AND CONVEYANCES BY COMMERCE AND NAVIGATION.
W69-05349 06E

MOORING AND FASTENING BOATS UPON RIPARIAN LANDS.
W69-05357 06E

STATE ACQUISITION OF RIPARIAN LANDS LEASE FOR COMMERCIAL ENTERPRISES.
W69-05358 06E

STATE SQUIRE V CITY OF CLEVELAND (FILL LAND AND HIGHWAY USE AS TO LITTORAL RIGHTS).
W69-05555 04C

RIPARIAN LESSOR
DELINQUENT RIPARIAN LEASES RE-ENTRY BY THE STATE.
W69-05356 06E

RIPARIAN RIGHTS
WATER LAW, POLITICS, AND ECONOMICS OUR COMPLEX WATER LAWS AND WATER USE CUSTOMS,
W69-05296 06E

ESTABLISHMENT OF STATE CONTROL OVER SUBMERGED LANDS.
W69-05347 06E

TRESPASS ON LANDS OF STATE UNDERWATER AND CONVEYANCES BY COMMERCE AND NAVIGATION.
W69-05349 06E

USAGE OF SUBMERGED LAND LEASE AND GRANT CONDITIONS AND PROCEDURE.
W69-05351 06E

GRANTS OF SUBMERGED LANDS TO THE STATE, MUNICIPALITIES, AND OTHER SUBDIVISIONS.
W69-05353 06E

CONFIRMATORY LEASES AND GRANTS OF SUBMERGED LAND.
W69-05354 06E

ERRONEOUS GRANTS OF SUBMERGED LAND.
W69-05355 06E

DELINQUENT RIPARIAN LEASES RE-ENTRY BY THE STATE.
W69-05356 06E

MOORING AND FASTENING BOATS UPON RIPARIAN LANDS.
W69-05357 06E

JOHNSON V RAY (RIGHT TO CONSTRUCT RETAINING WALL)
W69-05382 04A

WATERS OF WHITE LAKE INC V FRICKE (OWNERSHIP OF LAKE BEDS).
W69-05383 06E

BURT V MUNGER (EROSION CONTROL AND LANDFILL BY RIPARIAN OWNER).
W69-05391 04A

ADKISSON V STARR (TITLE TO ACCRETION).
W69-05399 06E

WATER RESOURCES LAWS IN VIRGINIA (NATURAL SURFACE WATERCOURSES).
W69-05534 06E

WATER RESOURCES LAW IN VIRGINIA (OTHER WATER SOURCES).
W69-05536 06E

STATE SQUIRE V CITY OF CLEVELAND (FILL LAND AND HIGHWAY USE AS TO LITTORAL RIGHTS).
W69-05555 04C

MARINE AIR WAYS, INC V STATE (INTERFERENCE WITH NAVIGATION).
W69-05579 06E

RIVER BASIN COMMISSIONS
LARGE TREATMENT PLANTS OF THE EMSCHER ASSOCIATION AND THEIR IMPORTANCE FOR IMPROVING CONDITIONS OF THE RHINE,
W69-05218 05D

EL PASO WATER IMPROV DIST NO 1 V CITY OF EL PASO (RIGHT OF REMOVAL UNDER WATER SUPPLY CONTRACT).
W69-05558 06E

RIVER BASIN DEVELOPMENT
COMPREHENSIVE BASIN STUDY ON WHITE RIVER BASIN, ARKANSAS AND MISSOURI.
W69-05201 06B

A STATE VIEWPOINT ON RIVER BASIN PLANNING,
W69-05209 06B

DELAWARE RIVER BASIN COMPACT.
W69-05342 04A

W69-05343 04A

W69-05344 04A

RIVER CONTROL
THE TENNESSEE VALLEY AUTHORITY ECONOMIC IMPACT OF ITS COMPREHENSIVE WATER DEVELOPMENT PROGRAM,
W69-05502 06B

RIVERFLOW
BLACK RIVER REGULATING DIST. V ADIRONDACK LEAGUE CLUB (CONDEMNATION PROCEEDINGS).
W69-05591 06E

RIVERS
LARGE TREATMENT PLANTS OF THE EMSCHER ASSOCIATION AND THEIR IMPORTANCE FOR IMPROVING CONDITIONS OF THE RHINE,
W69-05218 05D

CORRECTING RIVER VELOCITIES MEASURED FROM AN UNANCHORED SHIP,
W69-05255 07B

RIVERS AND HARBORS ACT
THE ORIGIN AND DEVELOPMENT OF THE WATERWAYS POLICY OF THE UNITED STATES,
W69-05338 04A

ROAD DESIGN
OSTLUND V STEARNS COUNTY (ARTIFICIAL ACCUMULATION OF SURFACE WATERS).
W69-05577 06E

ROSWELL PLANT
A PILOT PLANT STUDY FOR REMOVAL OF SOLUBLE SILICA FROM ROSWELL, NEW MEXICO WATER. PHASE 1. INITIAL CONSTRUCTION AND OPERATION,
W69-05335 03A

ROSWELL WATER
BASIC STUDIES OF SCALE CONTROL,
W69-05334 03A

W69-05334 03A

ROTATIONS
TILLAGE METHODS TO REDUCE RUNOFF AND EROSION IN THE CORN BELT,
W69-05330 03F

ROUTING
AN EXPERIMENTAL INVESTIGATION OF PARTIAL AREA CONTRIBUTIONS,
W69-05227 02A

NUMERICAL FORECASTING OF MOUNTAIN RIVER FLOOD RUNOFF ON THE BASIS OF ESTABLISHING TERRITORIALLY - GENERALIZED RELATIONSHIPS,
W69-05231 02A

THE ASSESSMENT OF SURFACE RUNOFF FROM RAINFALL DATA FOR AN ARID REGION OF WEST PAKISTAN,
W69-05232 02E

THE ASSESSMENT OF RUNOFF FROM A MOUNTAINOUS AND SEMI-ARID AREA IN WESTERN IRAN,
W69-05233 02E

ROW SPACING
VARIABLE ROW SPACING OF IRRIGATED COTTON AS A MEANS FOR REDUCING PRODUCTION COSTS AND CONSERVING WATER,
W69-05277 03F

RUNOFF
AN EXPERIMENTAL INVESTIGATION OF PARTIAL AREA CONTRIBUTIONS,
W69-05227 02A

RUNOFF WATER-SPREADING ON LEVELED CROPLAND,
W69-05275 04A

FLAT CHANNEL TERRACES,
W69-05282 02J

PREPARATION OF CO-ORDINATED PRECIPITATION, RUNOFF AND EVAPORATION MAPS,
W69-05337 02A

RELATION OF SOIL PROPERTIES TO ITS ERODIBILITY,
W69-05444 02J

DESTEFANO V MEGLIO (DAMAGES FOR OBSTRUCTION OF A DRAIN).
W69-05543 06E

NEWTON V LYONS (COMMON ENEMY EXCEPTION).
W69-05545 06E

RUNOFF FORECASTING
RUNOFF VOLUME PREDICTION FROM DAILY CLIMATIC DATA,
W69-05426 02A

USING ANALITICAL METHODS TO DEVELOP A SURFACE-RUNOFF MODEL,
W69-05431 02A

RUNOFF HYDROGRAPH AS A FUNCTION OF RAINFALL EXCESS,
W69-05438 02A

RURAL AREAS
PROCEEDINGS OF SYMPOSIUM ON BETTER WATER AND SEWER SERVICES FOR SMALL COMMUNITIES IN NORTH CAROLINA,
W69-05424 06B

SALINE WATER INTRUSION
WATER SUPPLY IN THE BRACKISH-WATER REGIONS OF SOUTH VIETNA
W69-05457 02L

SALT WATER ENCROACHMENT IN KARST AQUIFERS, ISLAND OF KEPHALLINIA, (IONIAN),
W69-05472 02L

SALT-WATER ENCROACHMENT OF TERTIARY LIMESTONE ALONG COASTA
SOUTH CAROLINA,
W69-05473 02L

SALINE WATER-FRESH WATER INTERFACE
SALT-WATER ENCROACHMENT OF TERTIARY LIMESTONE ALONG COASTA
SOUTH CAROLINA,
W69-05473 02L

SALINE WATER-FRESH WATER INTERFACES
SALT WATER ENCROACHMENT IN KARST AQUIFERS, ISLAND OF KEPHALLINIA, (IONIAN),
W69-05472 02L

SALINITY
ASSESSING IMPACTS OF DECLINING WATER QUALITY ON GROSS VALU
OUTPUT OF AGRICULTURE, A CASE STUDY,
W69-05273 03C

SALT RIVER VALLEY
WATER MANAGEMENT OF FALL-PLANTED SUGAR BEETS IN SALT RIVER
VALLEY OF ARIZONA,
W69-05279 03F

SAMPLING
COMPARISON OF RESULTS USING THREE SAMPLING TECHNIQUES FOR
FLUOMETRIC DYE STUDY IN A STREAM,
W69-05239 07B

RAPID FIELD FILTRATION OF WATER SAMPLES,
W69-05244 07B

SAMPLING APPARATUS TO MINIMIZE AERATION OF WATER FOR THE DETERMINATION OF DISSOLVED GASES,
W69-05246 07B

VARIABLE-SPEED POWER EQUIPMENT FOR DEPTH-INTEGRATION SEDIMENT SAMPLING,
W69-05257 07B

ELECTRIC CONTROL SYSTEM FOR DUAL OPERATION OF CURRENT METE
AND SUSPENDED-SEDIMENT SAMPLER,
W69-05258 07B

SATURATED FLOW
THE MECHANISM OF NATURAL GROUND-WATER RECHARGE AND DISCHAR
1. ONE-DIMENSIONAL, VERTICAL, UNSTEADY, UNSATURATED FLOW ABOVE A RECHARGING OR DISCHARGING GROUND-WATER FLOW SYSTEM
W69-05436 02F

SCALE VERSUS PROCESS VARIABLES
BASIC STUDIES OF SCALE CONTROL,
W69-05334 03A

SCALING
BASIC STUDIES OF SCALE CONTROL,
W69-05334 03A

A PILOT PLANT STUDY FOR REMOVAL OF SOLUBLE SILICA FROM ROSWELL, NEW MEXICO WATER. PHASE 1. INITIAL CONSTRUCTION AND OPERATION,
W69-05335 03A

SEASONAL
SEASONAL AND DIURNAL VARIATION IN POCOSIN SHRUB MOISTURE CONTENT,
W69-05331 02I

SEDIMENT PROFILES
PREDICTION OF SEDIMENT PROFILES IN OPEN CHANNEL FLOW BY TURBULENT DIFFUSION THEORY,
W69-05403 02J

SEDIMENT TRANSPORT
PREDICTION OF SEDIMENT PROFILES IN OPEN CHANNEL FLOW BY TURBULENT DIFFUSION THEORY,
W69-05403 02J

SEDIMENTATION
POIRE V SERRA (PROPRIETY OF LAND FILL BY RIPARIAN OWNER).
W69-05381 04A

SEDIMENTS
VARIABLE-SPEED POWER EQUIPMENT FOR DEPTH-INTEGRATION SEDIMENT SAMPLING,
W69-05257 07B

REYNOLDS METAL CO V BALL (SUIT TO RECOVER DAMAGES FOR ALLEGED DEPOSIT OF SEDIMENT CONTAINING POISONOUS SUBSTANCES).
W69-05385 05C

TENNESSEE VALLEY SAND AND GRAVEL CO V PILLING (LIABILITY F
SEDIMENT DUMPING WHICH MAKES CREEK BED SHALLOWER, WHICH CAUSES MORE FLOODING).
W69-05386 05G

SEEPAGE
PETERSON V WISCONSIN RIVER POWER CO (PROPERTY ENCROACHMENT BY IMPOUNDED WATERS).
W69-05552 04A

SEISMIC STUDIES
EVALUATION OF SOME GEOPHYSICAL TECHNIQUES APPLIED TO THE ENVIRONMENT OF A MAUI WELL,
W69-05418 02F

SERIAL CORRELATION
EFFECT OF THE LENGTH OF THE TIME PERIOD ON SERIAL CORRELATION,
W69-05506 06D

USE OF THE DURBIN-WATSON STATISTIC IN INAPPROPRIATE SITUATIONS,
W69-05516 06D

SESTON
A CONTINUOUS SIZE SPECTRUM FOR PARTICULATE MATTER IN THE SEA,
W69-05529 07C

SEWAGE
PROCEEDINGS OF SYMPOSIUM ON BETTER WATER AND SEWER SERVICES FOR SMALL COMMUNITIES IN NORTH CAROLINA,
W69-05424 06B

SEWAGE EFFLUENTS
MASONITE CORPORATION V GUY (FISHKILL EFFECTS OF WATER POLLUTION).
W69-05553 05C

SEWERAGE
WATER SUPPLY PROBLEMS IN DEVELOPING COUNTRIES,
W69-05513 03D

SHIPS
CORRECTING RIVER VELOCITIES MEASURED FROM AN UNANCHORED SHIP,
W69-05255 07B

SHORE PROTECTION
BEACH FRONTS AND WATERWAYS.
W69-05363 04A

SIGNIFICANCE POINTS
TESTING FOR SERIAL CORRELATION AFTER LEAST SQUARES REGRESSION,
W69-05289 06B

SILICA
A PILOT PLANT STUDY FOR REMOVAL OF SOLUBLE SILICA FROM ROSWELL, NEW MEXICO WATER. PHASE 1. INITIAL CONSTRUCTION AND OPERATION,
W69-05335 03A

SITES
SELECTION OF DYE-INJECTION AND MEASURING SITES FOR TIME-OF-TRAVEL STUDIES,
W69-05238 07B

SLASH PINE TREES
SOIL OR FOLIAR FERTILIZATION OF WELL-DRAINED AND FLOODED SLASH PINE,
W69-05332 02G

SLOPE STABILIZATION
TILLAGE METHODS TO REDUCE RUNOFF AND EROSION IN THE CORN BELT,
W69-05330 03F

SLOPES
MOUNTAIN RIVER FLOOD RUNOFF THEORY, MEANS OF ITS INVESTIGATION AND CALCULATION,
W69-05230 02A

NUMERICAL FORECASTING OF MOUNTAIN RIVER FLOOD RUNOFF ON THE BASIS OF ESTABLISHING TERRITORIALLY - GENERALIZED RELATIONSHIPS,
W69-05231 02A

SMALL WATERSHEDS
A PROPOSED MECHANICS FOR THE INVESTIGATION OF SURFACE RUNOFF FROM SMALL WATERSHEDS. 1, DEVELOPMENT,
W69-05425 02A

PREDICTING TEMPERATURES OF SMALL STREAMS,
W69-05427 02E

SNOW COVER
SNOW ACCUMULATION AS RELATED TO METEOROLOGICAL, TOPOGRAPHIC, AND FOREST VARIABLES IN CENTRAL SIERRA NEVADA, CALIFORNIA,
W69-05226 02C

SNOWFALL
SNOW ACCUMULATION AS RELATED TO METEOROLOGICAL, TOPOGRAPHIC, AND FOREST VARIABLES IN CENTRAL SIERRA NEVADA, CALIFORNIA,
W69-05226 02C

SOCIAL ADJUSTMENT
INTERGRATING HUMAN-SOCIAL RESOURCES INTO THE WATER RESOURCE DEVELOPMENT PROJECT,
W69-05217 06B

SOCIAL ASPECTS
INTERGRATING HUMAN-SOCIAL RESOURCES INTO THE WATER RESOURCE DEVELOPMENT PROJECT,
W69-05217 06B

SOCIAL VALUE
WELFARE ECONOMICS, ECONOMIC GROWTH AND THE CHOICE OF TECHNIQUES,
W69-05500 06B

SOIL
DETERMINATION OF ORGANOCHLORINE INSECTICIDES IN SOILS AND WATERS,
W69-05325 05A

SOIL BACTERIA
PESTICIDE LEVELS AND FLUCTUATION IN SOIL BACTERIA IN AN IRRIGATED FIELD AND A POND OF SOUTHWEST TEXAS,
W69-05272 05C

SOIL CONSERVATION DISTRICT
LEGAL ASPECTS OF THE SMALL WATERSHED PROGRAM IN IOWA,
W69-05339 04D

SOIL EROSION
TILLAGE METHODS TO REDUCE RUNOFF AND EROSION IN THE CORN BELT,
W69-05330 03F

RELATION OF SOIL PROPERTIES TO ITS ERODIBILITY,
W69-05444 02J

COATES V UNITED STATES (TAKING OF PROPERTY FOR PUBLIC PURPOSE WITHOUT JUST COMPENSATION).
W69-05554 04A

SOIL MANAGEMENT
TILLAGE METHODS TO REDUCE RUNOFF AND EROSION IN THE CORN BELT,
W69-05330 03F

SOIL MOISTURE
SOIL MOISTURE CONDITIONS UNDER PASTURES OF COOL-SEASON AND WARM-SEASON GRASSES,
W69-05266 02G

MOISTURE-RETENTION CAPACITY OF LITTER UNDER TWO ARIZONA CHAPARRAL COMMUNITIES,
W69-05267 02G

A METHOD OF DETERMINING EVAPOTRANSPIRATION IN SOIL MONOLITHS,
W69-05270 02D

THE INTERCEPTION-TRANSPIRATION RELATIONSHIP OF WHITE SPRUCE AND WHITE PINE,
W69-05274 02D

EFFECT OF EARLY-SUMMER SEEDING OF WINTER WHEAT ON YIELD, SOIL MOISTURE, AND SOIL NITRATE,
W69-05280 03F

STUDIES OF METHODS OF SOIL WATER DETERMINATION,
W69-05305 02G

RUNOFF VOLUME PREDICTION FROM DAILY CLIMATIC DATA,
W69-05426 02A

SOIL PHYSICAL PROPERTIES
RELATION OF SOIL PROPERTIES TO ITS ERODIBILITY,
W69-05444 02J

SOIL PROFILES
A METHOD OF DETERMINING EVAPOTRANSPIRATION IN SOIL MONOLITHS,
W69-05270 02D

SOIL STABILIZATION
ENGINEERING TECHNIQUES AND PRINCIPLES APPLIED TO SOIL EROSION CONTROL,
W69-05333 04D

SOIL SURFACES
SOIL PROBLEMS IN RESEEDING A GREASEWOOD-RABBITBRUSH RANGE SITE,
W69-05269 02G

SOIL WASTE TREATMENT
PUTTING WASTE WATER TO BENEFICIAL USE - THE FLUSHING MEADOWS PROJECT,
W69-05327 05D

RETURNING WASTES TO THE LAND, A NEW ROLE FOR AGRICULTURE,
W69-05328 05D

SOIL WATER
EFFECT OF MOISTURE REGIMES AND HARVESTS ON EFFICIENCY OF WATER USE BY TEN FORAGE CROPS,
W69-05268 02I

EFFECT OF FATTY ALCOHOL ON CHANGE IN SOIL WATER DURING THE SUMMER FALLOW PERIOD,
W69-05284 02G

STUDIES ON METHODS OF SOIL WATER DETERMINATION,
W69-05304 02G

STUDIES OF METHODS OF SOIL WATER DETERMINATION,
W69-05305 02G

SOIL OR FOLIAR FERTILIZATION OF WELL-DRAINED AND FLOODED SLASH PINE,
W69-05332 02G

HYDROLOGY OF A SLIDE-PRONE GLACIAL TILL SOIL IN SOUTHEAST ALASKA,
W69-05406 02G

SOIL WATER MOVEMENT
HYDROLOGY OF A SLIDE-PRONE GLACIAL TILL SOIL IN SOUTHEAST

ALASKA,
W69-05406 02G

ANALYZING STEADY-STATE FLOW IN AN INCLINED SOIL SLAB WITH AN ELECTRIC ANALOG,
W69-05440 02G

MOVEMENT OF WATER AND SALT THROUGH A CLAY-WATER SYSTEM EXPERIMENTAL VERIFICATION OF ONSAGER RECIPROCAL RELATION,
W69-05441 02G

THE EFFECT OF OSMOTIC PRESSURE GRADIENTS ON WATER MOVEMENT IN UNSATURATED SOIL,
W69-05442 02G

HYDRAULIC CONDUCTIVITY RELATED TO POROSITY AND SWELLING OF SOIL,
W69-05443 02G

SOUTH CAROLINA
SALT-WATER ENCROACHMENT OF TERTIARY LIMESTONE ALONG COASTAL SOUTH CAROLINA,
W69-05473 02L

EARLY V SOUTH CAROLINA PUBLIC SERVICE AUTHORITY (CONSTRUCTION OF DAM AND DIVERSION OF RIVER).
W69-05578 04A

SPAIN
DETERMINATION OF FRESH WATERS IN THE CALCAREOUS MASSIF OF 'COSTA BRAVA', SPAIN (FRENCH),
W69-05474 02F

SPECTRAL ANALYSIS
LONG SWINGS,
W69-05498 06B

THE TYPICAL SPECTRAL SHAPE OF AN ECONOMIC VARIABLE,
W69-05522 06D

SPECTRAL DENSITY FUNCTION
TESTING FOR SERIAL CORRELATION AFTER LEAST SQUARES REGRESSION,
W69-05289 06B

SPECTRAL SHAPE
THE TYPICAL SPECTRAL SHAPE OF AN ECONOMIC VARIABLE,
W69-05522 06D

SPRINKLER IRRIGATION
PREDICTING FIELD DISTRIBUTIONS OF SPRINKLER SYSTEMS,
W69-05285 03F

SQUARE FOOTAGE ASSESSMENT
MEYER V CITY OF OAKLAND (VALIDITY OF SPECIAL ASSESSMENTS TO LAND FOR SEWER IMPROVEMENTS).
W69-05542 06E

STAGE-DISCHARGE RELATIONS
PATTERNS OF BACKWATER AND DISCHARGE ON SMALL ICE-AFFECTED STREAMS,
W69-05256 07B

CHARACTERISTICS OF LOGARITHMIC RATING CURVES,
W69-05259 07B

FLOODS IN VIRGINIA - MAGNITUDE AND FREQUENCY,
W69-05415 02E

STAGNANT WATER
UNWHOLESOME PREMISES REMOVAL AND REHABILITATION AT OWNER'S EXPENSE.
W69-05376 05B

STATE GOVERNMENTS
ROLE OF STATE GOVERNMENTS IN U. S. WATER MANAGEMENT,
W69-05293 06E

TAKING OF WATERCRAFT, AIRCRAFT OR DRAFT ANIMALS INJURING OR CUTTING LOOSE BOOMS, RAFTS, VESSELS OR BOATS CIVIL ACTION FOR DAMAGES.
W69-05372 06E

TRESPASS - IMPROVED LANDS AND FISH PONDS.
W69-05566 06E

STATISTICAL METHODS
STATISTICAL ANALYSIS OF GROUND WATER USE AND REPLENISHMENT,
W69-05475 02F

STATISTICAL MODELS
RECURRENCE INTERVALS BETWEEN EXCEEDANCES OF SELECTED RIVER LEVELS. 2. ALTERNATIVES TO A MARKOV MODEL,
W69-05454 02E

FREQUENCY CURVES FOR ANNUAL FLOOD SERIES WITH SOME ZERO EVENTS OR INCOMPLETE DATA,
W69-05455 07C

STATISTICAL ANALYSIS OF GROUND WATER USE AND REPLENISHMENT,
W69-05475 02F

STEADY FLOW
ANALYZING STEADY-STATE FLOW IN AN INCLINED SOIL SLAB WITH AN ELECTRIC ANALOG,
W69-05440 02G

STEMFLOW
SEASONAL AND DIURNAL VARIATION IN POCOSIN SHRUB MOISTURE CONTENT,
W69-05331 02I

STOCHASTIC PROCESSES
A PROPOSED MECHANICS FOR THE INVESTIGATION OF SURFACE RUNO FROM SMALL WATERSHEDS. 1, DEVELOPMENT,
W69-05425 02A

STOMATA
STOMATAL OPENING IN ISOLATED EPIDERMAL STRIPS OF VICIA FAB I. RESPONSE TO LIGHT AND TO CO2-FREE AIR,
W69-05278 02I

STRAIN
MEASUREMENT OF SMALL SURFACE DISPLACEMENTS INDUCED BY FLUI FLOW,
W69-05433 02F

STRATIFICATION
THE MECHANICS OF STRATIFIED FLOW IN RESERVOIRS,
W69-05464 02H

DYNAMICS OF PHYSICOCHEMISTRY IN A LARGE RESERVOIR,
W69-05466 02H

WATER QUALITY IN IMPOUNDMENTS AND MODIFICATIONS FROM DESTRATIFICATION,
W69-05467 02H

STREAM GAGES
USE OF CARBON DIOXIDE IN BUBBLE GAGES TO PREVENT PRECIPITATION OF CALCIUM CARBONATE,
W69-05247 07B

POLYETHYLENE OIL TUBES FOR STILLING WELLS,
W69-05248 07B

WATER-STAGE AND RAINFALL DUAL RECORDER,
W69-05253 07B

PATTERNS OF BACKWATER AND DISCHARGE ON SMALL ICE-AFFECTED STREAMS,
W69-05256 07B

STREAM POLLUTION
MASONITE CORPORATION V GUY (FISHKILL EFFECTS OF WATER POLLUTION).
W69-05553 05C

STREAMFLOW
CORRECTING RIVER VELOCITIES MEASURED FROM AN UNANCHORED SHIP,
W69-05255 07B

COMPUTERIZED SYSTEM FOR WYOMING SURFACE WATER RECORDS,
W69-05326 02E

JOHNSON V RAY (RIGHT TO CONSTRUCT RETAINING WALL)
W69-05382 04A

FLOODS IN VIRGINIA - MAGNITUDE AND FREQUENCY,
W69-05415 02E

PREDICTING TEMPERATURES OF SMALL STREAMS,
W69-05427 02E

STREAMFLOW FORECASTING
THE ASSESSMENT OF SURFACE RUNOFF FROM RAINFALL DATA FOR AN ARID REGION OF WEST PAKISTAN,
W69-05232 02E

THE WEATHER BUREAU AND WATER MANAGEMENT.
W69-05336 07C

RUNOFF HYDROGRAPH AS A FUNCTION OF RAINFALL EXCESS,
W69-05438 02A

STREAMS
NUISANCES-MILLS AND DAMS FENCES AND BUILDINGS ON PUBLIC WAYS.
W69-05369 04A

STRUCTURES
BUDA V STATE (ARTIFICIAL CONTROL OF SURFACE WATERS).
W69-05550 04A

SUBMERGED LANDS ACT
UNITED STATES V STATE OF LOUISIANA (STATE OWNERSHIP OF SUBMERGED, CONTIGUOUS LANDS).
W69-05540 06E

SUBSURFACE DRAINAGE
JOHNSON V CITY OF WINSTON-SALEM (ACTION FOR DAMAGES CAUSED BY AN OBSTRUCTED DRAIN PIPE).
W69-05394 04A

SUGAR BEETS
WATER MANAGEMENT OF FALL-PLANTED SUGAR BEETS IN SALT RIVER VALLEY OF ARIZONA,
W69-05279 03F

SUMMER
EFFECT OF FATTY ALCOHOL ON CHANGE IN SOIL WATER DURING THE SUMMER FALLOW PERIOD,
W69-05284 02G

SUPPLY CONTRACTS
PEOPLE V VILLAGE OF BERKELEY (STATUTORY DUTIES UNDER WATER SUPPLY CONTRACTS).
W69-05584 06E

SURFACE DRAINAGE
DODD V BLEZEK (DETERMINATION OF DOMINANT ESTATE AND DRAINA

RIGHTS IN NATURAL STREAM).
W69-05393 04A

OSTLUND V STEARNS COUNTY (ARTIFICIAL ACCUMULATION OF SURFACE WATERS).
W69-05577 06E

NIXON V WELCH (SURFACE DRAINAGE EASEMENTS).
W69-05593 04A

JONES V LUCAS (SURFACE DRAINAGE).
W69-05594 04A

TALBOT V KERN (SERVITUDES OF DRAINAGE).
W69-05597 06E

LEWALLEN V DAVENPORT (DAMAGE FROM BACKING SURFACE RUNOFF).
W69-05600 04A

URFACE RUNOFF
QUALITY OF WATERS FROM PLAYAS ON THE SOUTHERN HIGH PLAINS,
W69-05276 03C

TILLAGE METHODS TO REDUCE RUNOFF AND EROSION IN THE CORN BELT,
W69-05330 03F

CITY OF HARDIN V NORBORNE LAND DRAINAGE DISTRICT (STATUTORY RIGHTS TO MAINTAIN EXISTING LEVEES).
W69-05384 04A

ENDERSON V KELEHAN (UPLAND DRAINAGE OF SURFACE WATERS).
W69-05390 04A

WATER RESOURCES LAW IN VIRGINIA.
W69-05533 06E

GWINN V MYERS (SUIT TO REMOVE OBSTRUCTION TO NATURAL WATERCOURSE).
W69-05557 04A

BIBERMAN V FUNKHOUSER (UPPER LANDOWNER'S RIGHT TO HAVE SURFACE WATER DRAIN UPON LOWER LANDOWNER).
W69-05570 06E

OSTLUND V STEARNS COUNTY (ARTIFICIAL ACCUMULATION OF SURFACE WATERS).
W69-05577 06E

URFACE WATER
COATES V UNITED STATES (TAKING OF PROPERTY FOR PUBLIC PURPOSE WITHOUT JUST COMPENSATION).
W69-05554 04A

MORRIS V WINTERS (ACTION TO REMOVE AN OBSTRUCTION TO WATER FLOW).
W69-05567 04A

URFACE WATERS
COMPUTERIZED SYSTEM FOR WYOMING SURFACE WATER RECORDS,
W69-05326 02E

TURNER V SMITH (RESERVOIR OBSTRUCTING LAND DRAINAGE).
W69-05392 04A

WATER-RESOURCES APPRAISAL OF THE SNAKE RIVER BASIN IN NEVADA,
W69-05414 02E

WATER RESOURCES OF THE BURNETT REGION,
W69-05423 02E

PHOSPHORUS IN FLOWING WATERS,
W69-05445 05B

WATER RESOURCES LAWS IN VIRGINIA (PERCOLATING GROUNDWATER - DIFFUSED SURFACE WATER).
W69-05535 06E

BOBO V YOUNG (ARTIFICIAL DRAINAGE OF SURFACE WATERS AND NATURAL FLOW).
W69-05551 04A

USPENDED LOAD
PREDICTION OF SEDIMENT PROFILES IN OPEN CHANNEL FLOW BY TURBULENT DIFFUSION THEORY,
W69-05403 02J

WALES
DODD V BLEZEK (DETERMINATION OF DOMINANT ESTATE AND DRAINAGE RIGHTS IN NATURAL STREAM).
W69-05393 04A

INOPTIC ANALYSIS
COMPARATIVE STUDY OF SNOW TYPE HYDROLOGY OF NORTHEASTERN CANADA AND OF PLAINS OF RUSSIA AND SIBERIA,
W69-05225 02E

YNTHETIC CARBONATE FREE SEAWATER
BASIC STUDIES OF SCALE CONTROL,
W69-05334 03A

W69-05334 03A

YNTHETIC HYDROGRAPHS
SYNTHETIC HYDROGRAPHS EFFECTS OF NETWORK GEOMETRY,
W69-05432 02A

YNTHETIC HYDROLOGY
SYNTHETIC HYDROGRAPHS EFFECTS OF NETWORK GEOMETRY,
W69-05432 02A

TAXATION
THE ORIGIN AND DEVELOPMENT OF THE WATERWAYS POLICY OF THE UNITED STATES,
W69-05338 04A

TAXES
A STUDY OF THE EFFECT OF TAXATION ON THE SIX PRIVATE OR QUASI-MUNICIPAL WATER UTILITIES IN RHODE ISLAND,
W69-05316 06C

HARBORS, WHARVES, AND HARBOR MASTERS.
W69-05377 04A

TECHNICAL WRITING
WRITING A WATER QUALITY REPORT,
W69-05212 10

TENNESSEE
WATER QUALITY INVESTIGATION, PART 1 - BASIC DATA, FORT LOUDOUN RESERVOIR, APRIL 1966 - JUNE 1968,
W69-05416 05A

TENNESSEE RIVER
WATER QUALITY INVESTIGATION, PART 1 - BASIC DATA, FORT LOUDOUN RESERVOIR, APRIL 1966 - JUNE 1968,
W69-05416 05A

TENNESSEE VALLEY AUTHORITY
THE TENNESSEE VALLEY AUTHORITY ECONOMIC IMPACT OF ITS COMPREHENSIVE WATER DEVELOPMENT PROGRAM,
W69-05502 06B

TERRACING
FLAT CHANNEL TERRACES,
W69-05282 02J

TEST PROCEDURES
FIELD MONITORING OF THE QUALITY OF WATER DURING THE DRILLING OF WELLS,
W69-05245 07B

TEXAS
QUALITY OF WATERS FROM PLAYAS ON THE SOUTHERN HIGH PLAINS,
W69-05276 03C

UNITED STATES V STATE OF LOUISIANA (STATE OWNERSHIP OF SUBMERGED, CONTIGUOUS LANDS).
W69-05540 06E

THERMAL STRATIFICATION
ARTIFICIAL MIXING OF DENSITY-STRATIFIED FLUIDS A LABORATORY INVESTIGATION,
W69-05412 02H

THERMOCOUPLE
ISOPIESTIC TECHNIQUE FOR MEASURING LEAF WATER POTENTIALS WITH A THERMOCOUPLE PSYCHROMETER,
W69-05286 02I

TIDAL WATERS
CONVEYANCES OF LANDS BY LEGISLATIVE AUTHORITY.
W69-05348 06E

TRESPASS ON LANDS OF STATE UNDERWATER AND CONVEYANCES BY COMMERCE AND NAVIGATION.
W69-05349 06E

TRUSTEES OF FREEHOLDERS AND COMMONALTY V MORRISEY (TITLE TO BEDS UNDER TIDAL WATERS).
W69-05388 06E

WATER RESOURCES LAW IN VIRGINIA.
W69-05533 06E

WATER RESOURCES LAW IN VIRGINIA (OTHER WATER SOURCES).
W69-05536 06E

TIDES
ON THE REPRESENTATION OF THE REYNOLDS STRESS IN A TIDAL ESTUARY,
W69-05213 02L

TIME PERIOD
EFFECT OF THE LENGTH OF THE TIME PERIOD ON SERIAL CORRELATION,
W69-05506 06D

TOPOGRAPHY
GRANITES, GRUSSES, AND THE SHERMAN EROSION SURFACE, SOUTHERN LARAMIE RANGE, COLORADO-WYOMING,
W69-05211 02J

SNOW ACCUMULATION AS RELATED TO METEOROLOGICAL, TOPOGRAPHIC, AND FOREST VARIABLES IN CENTRAL SIERRA NEVADA, CALIFORNIA,
W69-05226 02C

FLUID FLOW IN THE WESTERN CANADA SEDIMENTARY BASIN - 1. EFFECT OF TOPOGRAPHY,
W69-05451 02F

TOXICITY
DEMONSTRATION OF A TOXIN FROM APHANIZOMENON FLOS-AQUAE (L.) RALFS,
W69-05306 05C

REYNOLDS METAL CO V BALL (SUIT TO RECOVER DAMAGES FOR ALLEGED DEPOSIT OF SEDIMENT CONTAINING POISONOUS SUBSTANCES).
W69-05385 05C

TRACERS
TIME-OF-TRAVEL MEASUREMENTS AND OTHER APPLICATIONS OF DYE TRACING,
W69-05228 07B

IMPROVED DYES FOR WATER TRACING,
W69-05235 07B

NOMOGRAPHS FOR DETERMINING AMOUNT OF RHODAMINE B DYE FOR TIME-OF-TRAVEL STUDIES,
W69-05236 07B

CONSTANT-RATE-INJECTION EQUIPMENT FOR DYE-DILUTION DISCHARGE MEASUREMENTS,
W69-05237 07B

SELECTION OF DYE-INJECTION AND MEASURING SITES FOR TIME-OF-TRAVEL STUDIES,
W69-05238 07B

COMPARISON OF RESULTS USING THREE SAMPLING TECHNIQUES FOR A FLUOMETRIC DYE STUDY IN A STREAM,
W69-05239 07B

DYE-CLOUD PHOTOGRAPHY,
W69-05241 07B

TRACKING TECHNIQUES
TIME-OF-TRAVEL MEASUREMENTS AND OTHER APPLICATIONS OF DYE TRACING,
W69-05228 07B

TRANSMISSIVITY
A METHOD OF DETERMINING EVAPOTRANSPIRATION IN SOIL MONOLITHS,
W69-05270 02D

TRANSPIRATION
THE INTERCEPTION-TRANSPIRATION RELATIONSHIP OF WHITE SPRUCE AND WHITE PINE,
W69-05274 02D

TREND REMOVED DEVIATION FROM TREND
LONG SWINGS,
W69-05498 06B

TREND-SURFACE ANALYSIS
STATISTICAL ANALYSIS OF GROUND WATER USE AND REPLENISHMENT,
W69-05475 02F

TROPICAL OCEANS
EFFECTS OF PHOSPHATE CONCENTRATION ON CELL DIVISION RATES AND YIELD OF A TROPICAL OCEANIC DIATOM,
W69-05530 05C

TURBULENCE
ON THE REPRESENTATION OF THE REYNOLDS STRESS IN A TIDAL ESTUARY,
W69-05213 02L

UNACCOUNTED-FOR WATER
WATER SUPPLY PROBLEMS IN DEVELOPING COUNTRIES,
W69-05513 03D

UNDERDEVELOPED COUNTRIES
CAPITAL FORMATION AND GOVERNMENT CAPITAL POLICY IN DEVELOPING ECONOMIES,
W69-05518 06C

UNDERFLOW
UNITED STATES V KANSAS CITY LIFE INSURANCE CO (FLOODING, UNDERFLOWING).
W69-05572 04A

UNDERGROUND STREAMS
WATER RESOURCES LAWS IN VIRGINIA (PERCOLATING GROUNDWATER - DIFFUSED SURFACE WATER).
W69-05535 06E

UNITED STATES
NUCLEAR POWER AND WATER DESALTING PLANTS FOR SOUTHWEST UNITED STATES AND NORTHWEST MEXICO.
W69-05208 03A

MASSMAN-DRAKE V TOWBOAT M/V HUGH C BLASKE, BARGE CHEM 2 (ACTION FOR DAMAGES CAUSED BY A TOWBOAT CAST ADRIFT BY A HURRICANE).
W69-05341 06E

UNSATURATED FLOW
THE MECHANISM OF NATURAL GROUND-WATER RECHARGE AND DISCHARGE 1. ONE-DIMENSIONAL, VERTICAL, UNSTEADY, UNSATURATED FLOW ABOVE A RECHARGING OR DISCHARGING GROUND-WATER FLOW SYSTEM,
W69-05436 02F

THE EFFECT OF OSMOTIC PRESSURE GRADIENTS ON WATER MOVEMENT IN UNSATURATED SOIL,
W69-05442 02G

UNSTEADY FLOW
COMPARISON OF FLOOD-WAVE AND WATER-PARTICLE TRAVELTIMES,
W69-05240 02E

UNSTEADY FLOW PARAMETERS IN HYDRAULIC DESIGN,
W69-05408 08B

TRANSIENT FLOW OF GROUND WATER TO WELLS IN MULTIPLE-AQUIFER SYSTEMS,
W69-05413 02F

THE MECHANISM OF NATURAL GROUND-WATER RECHARGE AND DISCHARGE 1. ONE-DIMENSIONAL, VERTICAL, UNSTEADY, UNSATURATED FLOW ABOVE A RECHARGING OR DISCHARGING GROUND-WATER FLOW SYSTEM
W69-05436 02F

UTAH
THE ECONOMICS OF WATER ALLOCATION IN UTAH,
W69-05507 06D

UTILITIES
MALICIOUS MISCHIEFS-PUBLIC UTILITIES.
W69-05374 04C

NAVIGABLE STREAMS, PERMISSION TO BRIDGE OR DAM PUBLIC SERVICE FACILITIES NATURAL RESOURCES.
W69-05564 06E

VALUE JUDGMENTS
WELFARE ECONOMICS, ECONOMIC GROWTH AND THE CHOICE OF TECHNIQUES,
W69-05500 06B

VARIABILITY
RELATIONSHIP OF PALMER DROUGHT VARIABLES TO YIELD OF WINTE WHEAT,
W69-05283 03F

VELOCITY
CORRECTING RIVER VELOCITIES MEASURED FROM AN UNANCHORED SHIP,
W69-05255 07B

VESSELS
MASSMAN-DRAKE V TOWBOAT M/V HUGH C BLASKE, BARGE CHEM 2 (ACTION FOR DAMAGES CAUSED BY A TOWBOAT CAST ADRIFT BY A HURRICANE).
W69-05341 06E

VIRGINIA
GARGAC V SMITH-ROWLAND CO (POLLUTION OF LAKE BY INDUSTRIAL WASTES).
W69-05387 05C

WATER RESOURCES LAW IN VIRGINIA (ARTIFICALLY CONFINED WATER).
W69-05537 02H

COMPLETION OF THE FAIRFAX COUNTY WATER AUTHORITY ACQUISITI PROGRAM.
W69-05539 03D

AMERICAN CYANAMID CO V COMMONWEALTH (POLLUTION ABATEMENT).
W69-05575 05G

WASHOUTS
EAST FORK DUCK CREEK WATERSHED NOBLE AND WASHINGTON COUNTIES, OHIO.
W69-05329 06B

WASTE TREATMENT
WATER QUALITY CHANGES IN CONFINED HOG WASTE TREATMENT,
W69-05417 05D

WASTE WATER DISPOSAL
PUTTING WASTE WATER TO BENEFICIAL USE - THE FLUSHING MEADO PROJECT,
W69-05327 05D

RETURNING WASTES TO THE LAND, A NEW ROLE FOR AGRICULTURE,
W69-05328 05D

WASTE WATER RECLAMATION
PUTTING WASTE WATER TO BENEFICIAL USE - THE FLUSHING MEADO PROJECT,
W69-05327 05D

RETURNING WASTES TO THE LAND, A NEW ROLE FOR AGRICULTURE,
W69-05328 05D

WASTE WATER TREATMENT
LARGE TREATMENT PLANTS OF THE EMSCHER ASSOCIATION AND THEI IMPORTANCE FOR IMPROVING CONDITIONS OF THE RHINE,
W69-05218 05D

TREATING COKE PLANT WASTE,
W69-05422 05D

WASTES
NITROGEN CICLE IN SURFACE AND SUBSURFACE WATERS,
W69-05323 05B

WATER
DETERMINATION OF ORGANOCHLORINE INSECTICIDES IN SOILS AND WATERS,
W69-05325 05A

WATER ALLOCATION
THE ECONOMICS OF WATER ALLOCATION IN UTAH,
W69-05507 06D

WATER ALLOCATION(POLICY)
DELAWARE RIVER BASIN COMPACT.
W69-05342 04A

WATER ALLOCATION SUPPLY AND DEMAND RELATIONSHIPS,
W69-05483 06B

DISCUSSION OF WATER ALLOCATION SUPPLY AND DEMAND RELATIONSHIPS,
W69-05485 06B

WATER ANALYSIS

SAMPLING APPARATUS TO MINIMIZE AERATION OF WATER FOR THE DETERMINATION OF DISSOLVED GASES,
W69-05246 07B

TER CHEMISTRY
QUALITY OF WATERS FROM PLAYAS ON THE SOUTHERN HIGH PLAINS,
W69-05276 03C

VARIATION IN THE COMPOSITION OF BRINE FROM THE SILVANIA FORMATION NEAR MIDLAND, MICHIGAN,
W69-05401 02F

TER CONSERVATION
VARIABLE ROW SPACING OF IRRIGATED COTTON AS A MEANS FOR REDUCING PRODUCTION COSTS AND CONSERVING WATER,
W69-05277 03F

TER DISTRIBUTION(APPLIED)
PREDICTING FIELD DISTRIBUTIONS OF SPRINKLER SYSTEMS,
W69-05285 03F

TER DISTRICTS
COMPLETION OF THE FAIRFAX COUNTY WATER AUTHORITY ACQUISITION PROGRAM.
W69-05539 03D

TER LAW
A LAWYER LOOKS AT WATER RESOURCE ECONOMICS,
W69-05292 06E

WATER RESOURCES POLICY AND POLITICAL INSTITUTIONS.
W69-05295 06B

TER LEVEL FLUCTUATIONS
HYDROLOGIC EFFECTS OF THE 1962-66 DROUGHT ON LONG ISLAND, N. Y.,
W69-05411 02A

TER LEVELS
WATER-MANOMETER-AIR-LINE ASSEMBLY FOR DETERMINING DEPTH TO WATER IN WELLS,
W69-05249 07B

MINIMUM AND MAXIMUM WATER-LEVEL RECORDING DEVICES,
W69-05250 07B

TER MANAGEMENT
DELAWARE RIVER BASIN COMPACT.
W69-05342 04A

W69-05343 04A

MAJOR RESEARCH PROBLEMS IN WATER QUALITY,
W69-05519 05G

TER MANAGEMENT(APPLIED)
THE FUNDAMENTAL ROLE OF WATER IN THE 'CASSA PER IL MEZZOGIORNO' DEVELOPMENT PROGRAMS FOR SOUTHERN ITALY,
W69-05216 06D

TECHNIQUES OF WATER MANAGEMENT OF LAKE OKEECHOBEE AND THE FLORIDA EVERGLADES,
W69-05223 04A

WATER MANAGEMENT OF FALL-PLANTED SUGAR BEETS IN SALT RIVER VALLEY OF ARIZONA,
W69-05279 03F

TREATED WATERSHED YIELDS IMPROVED WATER HARVEST,
W69-05410 03B

TER POLLUTION
SOURCES OF COAL MINE DRAINAGE POLLUTION, WHEELING CREEK WATERSHED, OHIO.
W69-05202 05B

DUMPING OF OIL.
W69-05370 05G

GREEN V MCCLOUD (ACTION TO ENJOIN SEWAGE FLOW).
W69-05389 05G

MAJOR RESEARCH PROBLEMS IN WATER QUALITY,
W69-05519 05G

W B RODDENBERY CO INC V CARTER (DAMAGES FOR POLLUTION OF STREAM).
W69-05559 05B

CLARK V GIFFORD-HILL AND CO (WATER POLLUTION BY MINING).
W69-05561 05G

AMERICAN CYANAMID CO V COMMONWEALTH (POLLUTION ABATEMENT).
W69-05575 05G

TER POLLUTION CONTROL
DELAWARE RIVER BASIN COMPACT.
W69-05344 04A

WATER POLLUTION CONTROL USING BY-PASS PIPING,
W69-05503 05G

AMERICAN CYANAMID CO V COMMONWEALTH (POLLUTION ABATEMENT).
W69-05575 05G

STATE V GLIDDEN CO (CONSTITUTIONALITY OF WATER POLLUTIONS CONTROL STATUTE).
W69-05586 05G

TER POLLUTION EFFECTS
GARGAC V SMITH-ROWLAND CO (POLLUTION OF LAKE BY INDUSTRIAL WASTES).
W69-05387 05C

DEVELOPMENT OF BIOLOGICAL INDICES TO POLLUTION LEVELS IN STREAMS AFFECTED BY ACID MINE DRAINAGE AND OIL FIELD BRINE WASTES,
W69-05407 05A

A LIMNOLOGICAL RECONNAISSANCE OF AN IMPOUNDMENT RECEIVING HEAVY METALS WITH EMPHASIS OF DIATOMS AND FISH,
W69-05465 02H

WATER POLLUTION SOURCES
OIL SPILLAGE STUDY, LITERATURE SEARCH, AND CRITICAL EVALUATION FOR SELECTION OF PROMISING TECHNIQUES TO CONTROL AND PREVENT DAMAGE,
W69-05262 05G

NITROGEN CYCLE IN SURFACE AND SUBSURFACE WATERS,
W69-05323 05B

REYNOLDS METAL CO V BALL (SUIT TO RECOVER DAMAGES FOR ALLEGED DEPOSIT OF SEDIMENT CONTAINING POISONOUS SUBSTANCES).
W69-05385 05C

COMPONENTS OF WOOD PULP BLEACH EFFLUENTS,
W69-05402 05A

IDENTIFICATION AND DIFFERENTIATION OF HEAVY RESIDUAL OIL AND ASPHALT POLLUTANTS IN SURFACE WATERS BY COMPARATIVE RATIOS OF INFRARED ABSORBANCES,
W69-05421 05A

WATER POLLUTION TREATMENT
LARGE TREATMENT PLANTS OF THE EMSCHER ASSOCIATION AND THEIR IMPORTANCE FOR IMPROVING CONDITIONS OF THE RHINE,
W69-05218 05D

OIL SPILLAGE STUDY, LITERATURE SEARCH, AND CRITICAL EVALUATION FOR SELECTION OF PROMISING TECHNIQUES TO CONTROL AND PREVENT DAMAGE,
W69-05262 05G

WATER POTENTIAL
ISOPIESTIC TECHNIQUE FOR MEASURING LEAF WATER POTENTIALS WITH A THERMOCOUPLE PSYCHROMETER,
W69-05286 02I

WATER PURIFICATION
PORTABLE WATER PURIFIERS FOR COSTA RICA,
W69-05456 05D

WATER QUALITY
ASSESSING IMPACTS OF DECLINING WATER QUALITY ON GROSS VALUE OUTPUT OF AGRICULTURE, A CASE STUDY,
W69-05273 03C

QUALITY OF WATERS FROM PLAYAS ON THE SOUTHERN HIGH PLAINS,
W69-05276 03C

THE PLAN AND PROGRAM FOR THE BRANDYWINE.
W69-05299 06B

WATER QUALITY INVESTIGATION, PART 1 - BASIC DATA, FORT LOUDOUN RESERVOIR, APRIL 1966 - JUNE 1968,
W69-05416 05A

PREDICTING TEMPERATURES OF SMALL STREAMS,
W69-05427 02E

DYNAMICS OF PHYSICOCHEMISTRY IN A LARGE RESERVOIR,
W69-05466 02H

WATER QUALITY IN IMPOUNDMENTS AND MODIFICATIONS FROM DESTRATIFICATION,
W69-05467 02H

EVALUATION OF PRE-IMPOUNDMENT CONDITIONS FOR PREDICTION OF STORED WATER QUALITY,
W69-05468 02H

EFFECT OF IMPOUNDMENTS ON PRODUCTIVITY, WATER CHEMISTRY, AND HEAT BUDGETS OF RIVERS,
W69-05469 02H

MAJOR RESEARCH PROBLEMS IN WATER QUALITY,
W69-05519 05G

QUALITY WATER'S FOURTH DIMENSION,
W69-05524 05G

THE COMPETITION FOR WATER QUALITY AGRICULTURE,
W69-05525 05G

THE COMPETITION FOR WATER QUALITY INDUSTRY,
W69-05526 05G

THE COMPETITION FOR WATER QUALITY DOMESTIC USE,
W69-05527 05G

WATER QUALITY CONTROL
WATER POLLUTION CONTROL USING BY-PASS PIPING,
W69-05503 05G

MAJOR RESEARCH PROBLEMS IN WATER QUALITY,
W69-05519 05G

WATER QUALITY MANAGEMENT
WATER POLLUTION CONTROL USING BY-PASS PIPING,
W69-05503 05G

WATER RATES
PROCEEDINGS WATER POLICY PRICING CONFERENCE,
W69-05492 06C

LEGAL CONSTRAINTS IN WATER PRICING POLICY,
W69-05493 06C

THE ACCOUNTANT'S VIEWPOINT ON WATER PRICING POLICY,
W69-05494 06C

THE CONSUMER'S VIEWPOINT AND POLICY DECISIONS,
W69-05495 06C

STATEMENT,
W69-05497 06C

ECONOMIC ANALYSIS OF PUBLIC WATER SUPPLY IN THE PISCATAQUA RIVER WATERSHED,
W69-05510 03E

WATER REQUIREMENTS
STUDIES ON WATER USE IN PEA (PISUM SATIVUM L.),
W69-05287 03F

THE INTERINDUSTRY FACTOR-CONTEXT MATRIX AN APPLICATION FOR THE ANALYSIS AND PROJECTION OF REGIONAL WATER REQUIREMENTS,
W69-05509 06B

WATER RESOURCE DEVELOPMENT
CONCEPTUAL ISSUES IN THE CONDUCT OF REGIONAL RESEARCH ON THE ECONOMICS OF WATER,
W69-05480 06B

WATER RESOURCES
WATER LAW, POLITICS, AND ECONOMICS FEDERAL CONTROL OF WATER RESOURCES,
W69-05297 06E

WATER RESOURCES OF THE SALMON FALLS CREEK BASIN, IDAHO-NEVADA,
W69-05409 02E

WATER-RESOURCES APPRAISAL OF THE SNAKE RIVER BASIN IN NEVADA,
W69-05414 02E

WATER RESOURCES OF THE BURNETT REGION,
W69-05423 02E

WATER RESOURCES DEVELOPMENT
COMPREHENSIVE BASIN STUDY ON WHITE RIVER BASIN, ARKANSAS AND MISSOURI.
W69-05201 06B

A STATE VIEWPOINT ON RIVER BASIN PLANNING,
W69-05209 06B

THE FUNDAMENTAL ROLE OF WATER IN THE 'CASSA PER IL MEZZOGIORNO' DEVELOPMENT PROGRAMS FOR SOUTHERN ITALY,
W69-05216 06D

INTERGRATING HUMAN-SOCIAL RESOURCES INTO THE WATER RESOURCE DEVELOPMENT PROJECT,
W69-05217 06B

THE ORGANIZATION OF VENEZUELA FOR THE UTILIZATION OF ITS WATER RESOURCES (SPANISH),
W69-05220 06E

WATER RESOURCES POLICY AND POLITICAL INSTITUTIONS.
W69-05295 06B

PROCEEDINGS OF SYMPOSIUM ON BETTER WATER AND SEWER SERVICES FOR SMALL COMMUNITIES IN NORTH CAROLINA,
W69-05424 06B

WATER SUPPLY IN THE BRACKISH-WATER REGIONS OF SOUTH VIETNAM.
W69-05457 02L

STATISTICAL ANALYSIS OF GROUND WATER USE AND REPLENISHMENT,
W69-05475 02F

THE TENNESSEE VALLEY AUTHORITY ECONOMIC IMPACT OF ITS COMPREHENSIVE WATER DEVELOPMENT PROGRAM,
W69-05502 06B

WATER RESOURCES PLANNING
PROCEEDINGS-SYMPOSIUM ON BETTER WATER AND SEWER SERVICES FOR SMALL COMMUNITIES IN NORTH CAROLINA.
W69-05312 03D

WATER RESOURCES PLANNING ACT
A STATE VIEWPOINT ON RIVER BASIN PLANNING,
W69-05209 06B

WATER RESOURCES RESEARCH ACT
DISCUSSION OF REGIONAL RESEARCH IN THE NORTH CENTRAL REGION,
W69-05479 06B

WATER RIGHTS
WATER RESOURCES LAW IN VIRGINIA (ARTIFICALLY CONFINED WATER).
W69-05537 02H

LOCH SHELDRAKE ASSOCIATES V EVANS (RESTRICTIVE CLAUSE ON THE USES OF WATER).
W69-05548 06E

EL PASO WATER IMPROV DIST NO 1 V CITY OF EL PASO (RIGHT OF REMOVAL UNDER WATER SUPPLY CONTRACT).
W69-05558 06E

SCHEELER V DEWERD (EASEMENT TO TAKE WELL WATER).
W69-05595 06E

WATER SOURCES
WATER RESOURCES LAW IN VIRGINIA (OTHER WATER SOURCES).
W69-05536 06E

WATER RESOURCES LAW IN VIRGINIA (ARTIFICALLY CONFINED WATER).
W69-05537 02H

WATER SPREADING
RUNOFF WATER-SPREADING ON LEVELED CROPLAND,
W69-05275 04A

WATER STORAGE
RUNOFF WATER-SPREADING ON LEVELED CROPLAND,
W69-05275 04A

WATER SUPPLY
WATER FOR LIVING,
W69-05219 05C

DELAWARE AND RARITAN CANAL.
W69-05361 04A

ECONOMIC ANALYSIS OF PUBLIC WATER SUPPLY IN THE PISCATAQUA RIVER WATERSHED,
W69-05510 03E

WATER SUPPLY PROBLEMS IN DEVELOPING COUNTRIES,
W69-05513 03D

PEOPLE V VILLAGE OF BERKELEY (STATUTORY DUTIES UNDER WATER SUPPLY CONTRACTS).
W69-05584 06E

HUTCHESON V SUMRALL (WATER SUPPLY EASEMENT).
W69-05599 06E

WATER TABLE
IDENTIFICATION OF NONLINEAR PARAMETERS OF GROUND WATER BASINS BY HYBRID COMPUTATION,
W69-05271 02F

WATER TEMPERATURE
PREDICTING TEMPERATURES OF SMALL STREAMS,
W69-05427 02E

WATER UTILITIES
A STUDY OF THE EFFECT OF TAXATION ON THE SIX PRIVATE OR QUASI-MUNICIPAL WATER UTILITIES IN RHODE ISLAND,
W69-05316 06C

WATER UTILIZATION
DROUGHT AND PHOSPHORUS AFFECT GROWTH OF ANNUAL FORAGE LEGUMES,
W69-05264 02I

STUDIES ON WATER USE IN PEA (PISUM SATIVUM L.),
W69-05287 03F

ECONOMIC ANALYSIS OF PUBLIC WATER SUPPLY IN THE PISCATAQUA RIVER WATERSHED,
W69-05510 03E

LOCH SHELDRAKE ASSOCIATES V EVANS (RESTRICTIVE CLAUSE ON TH USES OF WATER).
W69-05548 06E

WATER VAPOR
ISOPIESTIC TECHNIQUE FOR MEASURING LEAF WATER POTENTIALS WITH A THERMOCOUPLE PSYCHROMETER,
W69-05286 02I

WATER WELLS
WATER-MANOMETER-AIR-LINE ASSEMBLY FOR DETERMINING DEPTH TO WATER IN WELLS,
W69-05249 07B

SCHEELER V DEWERD (EASEMENT TO TAKE WELL WATER).
W69-05595 06E

WATER WORKS
MALICIOUS MISCHIEFS-PUBLIC UTILITIES.
W69-05374 04C

COHASSET WATER CO V TOWN OF COHASSET (CONVEYANCE OF WATER WORKS TO TOWN).
W69-05583 06E

WATER YIELD IMPROVEMENT
TREATED WATERSHED YIELDS IMPROVED WATER HARVEST,
W69-05410 03B

WATERCOURSES
MORRIS CANAL AND BANKING COMPANY.
W69-05359 06E

WATERCOURSES(LEGAL)
GWINN V MYERS (SUIT TO REMOVE OBSTRUCTION TO NATURAL WATERCOURSE).
W69-05557 04A

WATERSHED MANAGEMENT
LEGAL ASPECTS OF THE SMALL WATERSHED PROGRAM IN IOWA,
W69-05339 04D

DELAWARE RIVER BASIN COMPACT.

W69-05345 04D

ATERSHED MANAGMENT
EAST FORK DUCK CREEK WATERSHED NOBLE AND WASHINGTON COUNTIES, OHIO.
W69-05329 06B

ATERSHED PROTECTION AND FLOOD PREVENTION ACT
LEGAL ASPECTS OF THE SMALL WATERSHED PROGRAM IN IOWA,
W69-05339 04D

ATERSHEDS
LEGAL ASPECTS OF THE SMALL WATERSHED PROGRAM IN IOWA,
W69-05339 04D

ATERSHEDS(BASINS)
RUNOFF WATER-SPREADING ON LEVELED CROPLAND,
W69-05275 04A

AVES(WATER)
WATER WAVES OVER A RECTANGULAR CHANNEL THROUGH A REEF,
W69-05448 02L

SHOALING OF SOLITARY WAVES ON SMALL SLOPES,
W69-05450 02H

EATHERING
GRANITES, GRUSSES, AND THE SHERMAN EROSION SURFACE, SOUTHERN LARAMIE RANGE, COLORADO-WYOMING,
W69-05211 02J

ELFARE(ECONOMICS)
AN INCOME-NET WORTH APPROACH TO MEASURING ECONOMIC WELFARE,
W69-05290 06B

ELL REGULATIONS
UNPROTECTED WELLS.
W69-05367 06E

ELLS
UNPROTECTED WELLS.
W69-05367 06E

ELLTON-MOHAWK IRRIGATION DISTRICT
ASSESSING IMPACTS OF DECLINING WATER QUALITY ON GROSS VALUE OUTPUT OF AGRICULTURE, A CASE STUDY,
W69-05273 03C

ESTERN CANADA BASIN
FLUID FLOW IN THE WESTERN CANADA SEDIMENTARY BASIN - 1. EFFECT OF TOPOGRAPHY,
W69-05451 02F

HEAT
EFFECTS OF MOISTURE AND FERTILIZER ON YIELDS OF SPRING WHEAT AND BARLEY,
W69-05263 02I

EFFECT OF EARLY-SUMMER SEEDING OF WINTER WHEAT ON YIELD, SOIL MOISTURE, AND SOIL NITRATE,
W69-05280 03F

RELATIONSHIP OF PALMER DROUGHT VARIABLES TO YIELD OF WINTER WHEAT,
W69-05283 03F

HEATGRASSES
SOIL PROBLEMS IN RESEEDING A GREASEWOOD-RABBITBRUSH RANGE SITE,
W69-05269 02G

WHITE PINE TREES
THE INTERCEPTION-TRANSPIRATION RELATIONSHIP OF WHITE SPRUCE AND WHITE PINE,
W69-05274 02D

WHITE RIVER
TANEY COUNTY V EMPIRE DIST ELECTRIC CO (FLOOD DAMAGE AND CLAIM SETTLEMENT FOR FUTURE DAMAGES).
W69-05571 06E

WHITE SPRUCE TREES
THE INTERCEPTION-TRANSPIRATION RELATIONSHIP OF WHITE SPRUCE AND WHITE PINE,
W69-05274 02D

WILDLIFE
NOTICE OF PETITIONS FOR SPECIAL LEGISLATION PERTAINING TO FISH AND GAME.
W69-05375 06E

SALT WATER ISLANDS.
W69-05565 06E

WINTER
RELATIONSHIP OF PALMER DROUGHT VARIABLES TO YIELD OF WINTER WHEAT,
W69-05283 03F

WISCONSIN
PETERSON V WISCONSIN RIVER POWER CO (PROPERTY ENCROACHMENT BY IMPOUNDED WATERS).
W69-05552 04A

MOENCH V PUBLIC SERVICE COMMISSION (PUBLIC RIGHTS IN NAVIGABLE RIVER).
W69-05582 06E

SCHEELER V DEWERD (EASEMENT TO TAKE WELL WATER).
W69-05595 06E

WORLD BANK
WATER SUPPLY PROBLEMS IN DEVELOPING COUNTRIES,
W69-05513 03D

YIELD EQUATIONS
EFFECTS OF PHOSPHATE CONCENTRATION ON CELL DIVISION RATES AND YIELD OF A TROPICAL OCEANIC DIATOM,
W69-05530 05C

ZINC RADIOISOTOPES
ACCUMULATION OF PHOSPHORUS-32 AND ZINC-65 BY LIVING AND KILLED PLANKTON,
W69-05531 05C

ZOOGLOEA BACTERIA
IDENTIFICATION OF ZOOGLOEA SPECIES AND THE RELATIONSHIP TO ZOOGLOEAL MATRIX AND FLOC FORMATION,
W69-05313 05C

ZOOGLOEAL MATRIX
IDENTIFICATION OF ZOOGLOEA SPECIES AND THE RELATIONSHIP TO ZOOGLOEAL MATRIX AND FLOC FORMATION,
W69-05313 05C

ZOOPLANKTON
LIMNOLOGICAL STUDIES OF LENTIC WATERS,
W69-05302 02H

BIOLOGICAL ASPECTS OF EUTROPHICATION IN LAKES MENDOTA, CRYSTAL, TROUT AND GREEN,
W69-05324 02H

AUTHOR INDEX

ADAMS, W. M.
EVALUATION OF SOME GEOPHYSICAL TECHNIQUES APPLIED TO THE ENVIRONMENT OF A MAUI WELL,
W69-05418 02F

AGUERREVERE, FRANCISCO G.
THE ORGANIZATION OF VENEZUELA FOR THE UTILIZATION OF ITS WATER RESOURCES (SPANISH),
W69-05220 06E

ALCALY, ROGER E.
A NOTE ON THE DUAL PRICES OF INTEGER PROGRAMS,
W69-05523 06C

ALKIRE, G. J.
OIL SPILLAGE STUDY, LITERATURE SEARCH, AND CRITICAL EVALUATION FOR SELECTION OF PROMISING TECHNIQUES TO CONTROL AND PREVENT DAMAGE,
W69-05262 05G

ANDERSON, HENRY W.
SNOW ACCUMULATION AS RELATED TO METEOROLOGICAL, TOPOGRAPHIC, AND FOREST VARIABLES IN CENTRAL SIERRA NEVADA, CALIFORNIA,
W69-05226 02C

APPLEGATE, HOWARD G.
PESTICIDE LEVELS AND FLUCTUATION IN SOIL BACTERIA IN AN IRRIGATED FIELD AND A POND OF SOUTHWEST TEXAS,
W69-05272 05C

ASANA, R. D.
MEASUREMENT OF DROUGHT RESISTANCE IN CROP PLANTS,
W69-05265 02G

ATTOE, O. J.
NITROGEN CYCLE IN SURFACE AND SUBSURFACE WATERS,
W69-05323 05B

BACHMAT, YEHUDA
HYDRODYNAMIC DISPERSION IN A SATURATED HOMOGENEOUS POROUS MEDIUM AT LOW PECLET NUMBERS AND NONHOMOGENEOUS SOLUTION,
W69-05434 01B

BAGLEY, W. S.
DISCUSSION OF CONCEPTUAL ISSUES IN THE CONDUCT OF REGIONAL RESEARCH ON THE ECONOMICS OF WATER,
W69-05481 06B

BAIRD, RALPH W.
RUNOFF VOLUME PREDICTION FROM DAILY CLIMATIC DATA,
W69-05426 02A

BALLANCE, W. C.
TREATED WATERSHED YIELDS IMPROVED WATER HARVEST,
W69-05410 03B

BARBAROSSA, NICHOLAS L.
A STATE VIEWPOINT ON RIVER BASIN PLANNING,
W69-05209 06B

BARFIELD, BILLY J.
PREDICTION OF SEDIMENT PROFILES IN OPEN CHANNEL FLOW BY TURBULENT DIFFUSION THEORY,
W69-05403 02J

BASLER, J. A.
TREATED WATERSHED YIELDS IMPROVED WATER HARVEST,
W69-05410 03B

BAUER, A.
EFFECTS OF MOISTURE AND FERTILIZER ON YIELDS OF SPRING WHEAT AND BARLEY,
W69-05263 02I

BECKER, C. D.
OIL SPILLAGE STUDY, LITERATURE SEARCH, AND CRITICAL EVALUATION FOR SELECTION OF PROMISING TECHNIQUES TO CONTROL AND PREVENT DAMAGE,
W69-05262 05G

BECKETT, HERBERT L.
THE ACCOUNTANT'S VIEWPOINT ON WATER PRICING POLICY,
W69-05494 06C

BEERMAN, PAUL
THE COMPETITION FOR WATER QUALITY DOMESTIC USE,
W69-05527 05G

BEFANI, A. W.
MOUNTAIN RIVER FLOOD RUNOFF THEORY, MEANS OF ITS INVESTIGATION AND CALCULATION,
W69-05230 02A

BEHL, M. K.
STUDIES ON WATER USE IN PEA (PISUM SATIVUM L.),
W69-05287 03F

BEIGHTLER, C. S.
OPTIMIZATION METHODS FOR BRANCHING MULTISTAGE WATER RESOURCE SYSTEMS--A REPLY TO A COMMENT BY E. F. BRATER,
W69-05501 06A

BELLA, ROBERT
WATER QUALITY CHANGES IN CONFINED HOG WASTE TREATMENT,
W69-05417 05D

BEMPANI, W. F.
NUMERICAL FORECASTING OF MOUNTAIN RIVER FLOOD RUNOFF ON THE BASIS OF ESTABLISHING TERRITORIALLY - GENERALIZED RELATIONSHIPS,
W69-05231 02A

BENOIT, RICHARD
A LIMNOLOGICAL RECONNAISSANCE OF AN IMPOUNDMENT RECEIVING HEAVY METALS WITH EMPHASIS OF DIATOMS AND FISH,
W69-05465 02H

BENSON, M. A.
FREQUENCY CURVES FOR ANNUAL FLOOD SERIES WITH SOME ZERO EVENTS OR INCOMPLETE DATA,
W69-05455 07C

BEN-SHAHAR, HAIM
CAPITAL FORMATION AND GOVERNMENT CAPITAL POLICY IN DEVELOPING ECONOMIES,
W69-05518 06C

BERGMANN, J. M.
RAINFALL-RUNOFF MODEL FOR SMALL BASIN FLOOD HYDROGRAPH SIMULATION,
W69-05420 02A

BERKSTRESSER, CHARLES F., JR.
RAPID FIELD FILTRATION OF WATER SAMPLES,
W69-05244 07B

BETSON, ROGER P.
USING ANALYTICAL METHODS TO DEVELOP A SURFACE-RUNOFF MODEL,
W69-05431 02A

BHAGAVANTAM, S.
KOYNA EARTHQUAKE OF DECEMBER 11, 1967,
W69-05419 08E

BLACKBURN, R. D.
COMMON AQUATIC WEEDS,
W69-05446 02I

BLACKMARR, W. H.
SEASONAL AND DIURNAL VARIATION IN POCOSIN SHRUB MOISTURE CONTENT,
W69-05331 02I

BOERSMA, L.
PORE SIZE DISTRIBUTIONS AS MEASURED BY THE MERCURY INTRUSION METHOD AND THEIR USE IN PREDICTING PERMEABILITY,
W69-05439 02G

BOURCIER, DONALD V.
ECONOMIC ANALYSIS OF PUBLIC WATER SUPPLY IN THE PISCATAQUA RIVER WATERSHED,
W69-05510 03E

BOUWER, HERMAN
PUTTING WASTE WATER TO BENEFICIAL USE - THE FLUSHING MEADOWS PROJECT,
W69-05327 05D

RETURNING WASTES TO THE LAND, A NEW ROLE FOR AGRICULTURE,
W69-05328 05D

BOYER, JOHN S.
ISOPIESTIC TECHNIQUE FOR MEASURING LEAF WATER POTENTIALS WITH A THERMOCOUPLE PSYCHROMETER,
W69-05286 02I

BRADLEY, IVER E.
THE ECONOMICS OF WATER ALLOCATION IN UTAH,
W69-05507 06D

BRADLEY, W. C.
GRANITES, GRUSSES, AND THE SHERMAN EROSION SURFACE, SOUTHERN LARAMIE RANGE, COLORADO-WYOMING,
W69-05211 02J

BRANSCHEID, WOLKER O.
PREDICTING FIELD DISTRIBUTIONS OF SPRINKLER SYSTEMS,
W69-05285 03F

BRATER, E. F.
A COMMENT ON OPTIMIZATION METHODS FOR BRANCHING MULTISTAGE WATER RESOURCE SYSTEMS,
W69-05499 06A

BRAZEE, ROSS D.
A PROPOSED MECHANICS FOR THE INVESTIGATION OF SURFACE RUNOFF FROM SMALL WATERSHEDS. 1, DEVELOPMENT,
W69-05425 02A

BRENGLE, K. G.
EFFECT OF FATTY ALCOHOL ON CHANGE IN SOIL WATER DURING THE SUMMER FALLOW PERIOD,
W69-05284 02G

BREWER, MICHAEL F.
ECONOMIC ALTERNATIVES,
W69-05528 05G

BROBERG, D. E.
FLAT CHANNEL TERRACES,
W69-05282 02J

BROWER, STEPHEN L.
INTEGRATING HUMAN-SOCIAL RESOURCES INTO THE WATER RESOURCE

DEVELOPMENT PROJECT,
W69-05217 06B

BROWNING, GEORGE M.
REGIONAL AND NATIONAL PLANNING OF AGRICULTURAL RESEARCH,
W69-05482 06B

BROWN, GEORGE W.
PREDICTING TEMPERATURES OF SMALL STREAMS,
W69-05427 02E

BROWN, MERLE J.
RELATIONSHIP OF PALMER DROUGHT VARIABLES TO YIELD OF WINTER WHEAT,
W69-05283 03F

BROWN, T. S.
A PILOT PLANT STUDY FOR REMOVAL OF SOLUBLE SILICA FROM ROSWELL, NEW MEXICO WATER. PHASE 1. INITIAL CONSTRUCTION AND OPERATION,
W69-05335 03A

BROWZIN, BORIS S.
COMPARATIVE STUDY OF SNOW TYPE HYDROLOGY OF NORTHEASTERN CANADA AND OF PLAINS OF RUSSIA AND SIBERIA,
W69-05225 02E

BRUSH, LUCIEN M.
ARTIFICIAL MIXING OF DENSITY-STRATIFIED FLUIDS A LABORATORY INVESTIGATION,
W69-05412 02H

BRYLKA, RUDOLF
PORTABLE WATER PURIFIERS FOR COSTA RICA,
W69-05456 05D

BUCHANAN, THOMAS J.
COMPARISON OF FLOOD-WAVE AND WATER-PARTICLE TRAVELTIMES,
W69-05240 02E

WATER-STAGE AND RAINFALL DUAL RECORDER,
W69-05253 07B

BUCHTA, H. G.
FLAT CHANNEL TERRACES,
W69-05282 02J

BURWELL, R. E.
TILLAGE METHODS TO REDUCE RUNOFF AND EROSION IN THE CORN BELT,
W69-05330 03F

CAIRNS, JOHN, JR.
A LIMNOLOGICAL RECONNAISSANCE OF AN IMPOUNDMENT RECEIVING HEAVY METALS WITH EMPHASIS OF DIATOMS AND FISH,
W69-05465 02H

CAMFIELD, FREDERICK E.
SHOALING OF SOLITARY WAVES ON SMALL SLOPES,
W69-05450 02H

CAMPBELL, CHARLES
LEGAL ASPECTS OF THE SMALL WATERSHED PROGRAM IN IOWA,
W69-05339 04D

CANDAU, M. G.
WATER FOR LIVING,
W69-05219 05C

CARPENTER, T. G.
THE ASSESSMENT OF RUNOFF FROM A MOUNTAINOUS AND SEMI-ARID AREA IN WESTERN IRAN,
W69-05233 02E

CASTLE, EMERY N.
CONCEPTUAL ISSUES IN THE CONDUCT OF REGIONAL RESEARCH ON THE ECONOMICS OF WATER,
W69-05480 06B

CERNY, EDWIN E.
PATTERNS OF BACKWATER AND DISCHARGE ON SMALL ICE-AFFECTED STREAMS,
W69-05256 07B

CHAPMAN, T. G.
RECURRENCE INTERVALS BETWEEN EXCEEDANCES OF SELECTED RIVER LEVELS. 2. ALTERNATIVES TO A MARKOV MODEL,
W69-05454 02E

CHESTERS, G.
DETERMINATION OF ORGANOCHLORINE INSECTICIDES IN SOILS AND WATERS,
W69-05325 05A

CHIN, Y. KUO
ARTIFICIAL MIXING OF DENSITY-STRATIFIED FLUIDS A LABORATORY INVESTIGATION,
W69-05412 02H

CHIZHOV, A. N.
PROBLEMS OF THE METHODS AND ACCURACY OF HYDROLOGIC OBSERVATIONS (RUSSIAN),
W69-05210 07A

CHOW, GREGORY C.
AN ALTERNATIVE PROOF OF HANNAN'S THEOREM ON CANONICAL CORRELATION AND MULTIPLE EQUATION SYSTEMS,
W69-05511 06D

CLARK, CHAPIN D.
WATER LAW, POLITICS, AND ECONOMICS OUR COMPLEX WATER LAWS AND WATER USE CUSTOMS,
W69-05296 06E

WATER LAW, POLITICS, AND ECONOMICS FEDERAL CONTROL OF WATER RESOURCES,
W69-05297 06E

COBB, ERNEST D.
CONSTANT-RATE-INJECTION EQUIPMENT FOR DYE-DILUTION DISCHARGE MEASUREMENTS,
W69-05237 07B

COHEN, PHILIP
HYDROLOGIC EFFECTS OF THE 1962-66 DROUGHT ON LONG ISLAND, N. Y.,
W69-05411 02A

COLLINGS, M. R.
SELECTION OF DYE-INJECTION AND MEASURING SITES FOR TIME-OF-TRAVEL STUDIES,
W69-05238 07B

COLLINS, J. W.
COMPONENTS OF WOOD PULP BLEACH EFFLUENTS,
W69-05402 05A

CONARD, E. C.
SOIL MOISTURE CONDITIONS UNDER PASTURES OF COOL-SEASON AND WARM-SEASON GRASSES,
W69-05266 02G

CONNOR, D. J.
TISSUE WATER RELATIONS FOR BRIGALOW AND MULGA,
W69-05281 02I

COOK, M. W.
OIL SPILLAGE STUDY, LITERATURE SEARCH, AND CRITICAL EVALUATION FOR SELECTION OF PROMISING TECHNIQUES TO CONTROL AND PREVENT DAMAGE,
W69-05262 05G

COOK, R. ELTON
PATTERNS OF BACKWATER AND DISCHARGE ON SMALL ICE-AFFECTED STREAMS,
W69-05256 07B

CORBALIS, JAMES J., JR.
COMPLETION OF THE FAIRFAX COUNTY WATER AUTHORITY ACQUISITION PROGRAM.
W69-05539 03D

COX, MAURICE B.
RUNOFF WATER-SPREADING ON LEVELED CROPLAND,
W69-05275 04A

COX, WILLIAM E.
WATER RESOURCES LAW IN VIRGINIA.
W69-05533 06E

WATER RESOURCES LAWS IN VIRGINIA (NATURAL SURFACE WATERCOURSES).
W69-05534 06E

WATER RESOURCES LAWS IN VIRGINIA (PERCOLATING GROUNDWATER - DIFFUSED SURFACE WATER).
W69-05535 06E

WATER RESOURCES LAW IN VIRGINIA (OTHER WATER SOURCES).
W69-05536 06E

WATER RESOURCES LAW IN VIRGINIA (ARTIFICALLY CONFINED WATER).
W69-05537 02H

WATER RESOURCES LAWS IN VIRGINIA (REMEDIES FOR INFRINGEMENT OF WATER RIGHTS).
W69-05538 06E

CRABTREE, K. T.
NITROGEN CYCLE IN SURFACE AND SUBSURFACE WATERS,
W69-05323 05B

CRIPPEN, J. R.
INTERPRETATION OF FLOOD-FREQUENCY DATA,
W69-05260 07B

CROSTHWAITE, E. G.
WATER RESOURCES OF THE SALMON FALLS CREEK BASIN, IDAHO-NEVADA,
W69-05409 02E

CURRY, R. BRUCE
A PROPOSED MECHANICS FOR THE INVESTIGATION OF SURFACE RUNOFF FROM SMALL WATERSHEDS. 1, DEVELOPMENT,
W69-05425 02A

CUSHING, C. E.
ACCUMULATION OF PHOSPHORUS-32 AND ZINC-65 BY LIVING AND KILLED PLANKTON,
W69-05531 05C

DAMBACH, CHARLES A.
DEVELOPMENT OF BIOLOGICAL INDICES TO POLLUTION LEVELS IN STREAMS AFFECTED BY ACID MINE DRAINAGE AND OIL FIELD BRINE WASTES,
W69-05407 05A

DANIELS, H. E.
AUTOCORRELATION BETWEEN FIRST DIFFERENCES OF MID-RANGES,
W69-05520 06B

DAVIS, DIANA
OIL SPILLAGE STUDY, LITERATURE SEARCH, AND CRITICAL EVALUATION FOR SELECTION OF PROMISING TECHNIQUES TO CONTROL AND PREVENT DAMAGE,
W69-05262 05G

DAVIS, D. W.
A PILOT PLANT STUDY FOR REMOVAL OF SOLUBLE SILICA FROM ROSWELL, NEW MEXICO WATER. PHASE 1. INITIAL CONSTRUCTION AND OPERATION,
W69-05335 03A

DAVIS, H. CRAIG
THE INTERINDUSTRY FACTOR-CONTEXT MATRIX AN APPLICATION FOR THE ANALYSIS AND PROJECTION OF REGIONAL WATER REQUIREMENTS,
W69-05509 06B

DAVIS, LUTHER C., JR.
CORRECTING RIVER VELOCITIES MEASURED FROM AN UNANCHORED SHIP,
W69-05255 07B

DAVIS, STANLEY N.
MEASUREMENT OF SMALL SURFACE DISPLACEMENTS INDUCED BY FLUID FLOW,
W69-05433 02F

DAWDY, D. R.
RAINFALL-RUNOFF MODEL FOR SMALL BASIN FLOOD HYDROGRAPH SIMULATION,
W69-05420 02A

DE ALESSI, LOUIS
THE UTILITY OF DISASTERS,
W69-05288 06B

DE HENRY, L.
WATER RESOURCES OF THE BURNETT REGION,
W69-05423 02E

DEBACKER, L. W.
PORE SIZE DISTRIBUTIONS AS MEASURED BY THE MERCURY INTRUSION METHOD AND THEIR USE IN PREDICTING PERMEABILITY,
W69-05439 02G

DEMONICO, J. P.
BASIC STUDIES OF SCALE CONTROL,
W69-05334 03A

DEWEY, W. G.
EFFECT OF EARLY-SUMMER SEEDING OF WINTER WHEAT ON YIELD, SOIL MOISTURE, AND SOIL NITRATE,
W69-05280 03F

DIDWANIA, H. P.
COMPONENTS OF WOOD PULP BLEACH EFFLUENTS,
W69-05402 05A

DODSON, ANNE N.
EFFECTS OF PHOSPHATE CONCENTRATION ON CELL DIVISION RATES AND YIELD OF A TROPICAL OCEANIC DIATOM,
W69-05530 05C

DOE, HANS H.
THE CONSUMER'S VIEWPOINT AND POLICY DECISIONS,
W69-05495 06C

DUGAN, PATRICK
THE MICROBIAL FLORA OF ACID MINE WATER AND ITS RELATIONSHIP TO FORMATION AND REMOVAL OF ACID,
W69-05314 05G

DUGAN, P. R.
IDENTIFICATION OF ZOOGLOEA SPECIES AND THE RELATIONSHIP TO ZOOGLOEAL MATRIX AND FLOC FORMATION,
W69-05313 05C

DUNN, BERNARD
NOMOGRAPHS FOR DETERMINING AMOUNT OF RHODAMINE B DYE FOR TIME-OF-TRAVEL STUDIES,
W69-05236 07B

DYLLA, A. S.
SOIL PROBLEMS IN RESEEDING A GREASEWOOD-RABBITBRUSH RANGE SITE,
W69-05269 02G

D'ACCADIA, R. DENTICE
THE FUNDAMENTAL ROLE OF WATER IN THE 'CASSA PER IL MEZZOGIORNO' DEVELOPMENT PROGRAMS FOR SOUTHERN ITALY,
W69-05216 06D

EAKIN, THOMAS E.
WATER-RESOURCES APPRAISAL OF THE SNAKE RIVER BASIN IN NEVADA,
W69-05414 02E

ECKERT, R. E., JR.
SOIL PROBLEMS IN RESEEDING A GREASEWOOD-RABBITBRUSH RANGE SITE,
W69-05269 02G

EGGLER, D. H.
GRANITES, GRUSSES, AND THE SHERMAN EROSION SURFACE, SOUTHERN LARAMIE RANGE, COLORADO-WYOMING,
W69-05211 02J

EGLESON, G. C.
VARIATION IN THE COMPOSITION OF BRINE FROM THE SYLVANIA FORMATION NEAR MIDLAND, MICHIGAN,
W69-05401 02F

ELDER, R. A.
THE MECHANICS OF STRATIFIED FLOW IN RESERVOIRS,
W69-05464 02H

EMBREE, WILLIAM N.
COMPUTERIZED SYSTEM FOR WYOMING SURFACE WATER RECORDS,
W69-05326 02E

ENGLISH, J. MORLEY
STATEMENT,
W69-05497 06C

ERIE, L. J.
WATER MANAGEMENT OF FALL-PLANTED SUGAR BEETS IN SALT RIVER VALLEY OF ARIZONA,
W69-05279 03F

ESPINOSA, MANUEL E.
DETERMINATION OF OPTIMUM CAPACITY OF A STORAGE RESERVOIR FOR IRRIGATION PURPOSES AS A BASIS FOR ALLOCATING COSTS IN MULTIPLE-PURPOSE PROJECTS,
W69-05294 03F

FABUSS, B. M.
BASIC STUDIES OF SCALE CONTROL,
W69-05334 03A

FIREMAN, MILTON
THE COMPETITION FOR WATER QUALITY AGRICULTURE,
W69-05525 05G

FISCHER, R. A.
STOMATAL OPENING IN ISOLATED EPIDERMAL STRIPS OF VICIA FABA. I. RESPONSE TO LIGHT AND TO CO2-FREE AIR
W69-05278 02I

FISK, P. R.
THE ESTIMATION OF MARGINAL PRODUCT FROM A COBB-DOUGLAS PRODUCTION FUNCTION,
W69-05521 06B

FLANNER, WILLIAM B.
SEASONAL AND DIURNAL VARIATION IN POCOSIN SHRUB MOISTURE CONTENT,
W69-05331 02I

FLECKSTEINER, JOHN W.
TREATING COKE PLANT WASTE,
W69-05422 05D

FLEMING, J. H.
THE ASSESSMENT OF SURFACE RUNOFF FROM RAINFALL DATA FOR AN ARID REGION OF WEST PAKISTAN,
W69-05232 02E

FORSTE, ROBERT H.
ECONOMIC ANALYSIS OF PUBLIC WATER SUPPLY IN THE PISCATAQUA RIVER WATERSHED,
W69-05510 03E

FOSTER, MINARD I.
BROAD SCOPE OF NAVIGATION'S ECONOMIC IMPACT,
W69-05449 06B

FRANKE, O. L.
HYDROLOGIC EFFECTS OF THE 1962-66 DROUGHT ON LONG ISLAND, N. Y.,
W69-05411 02A

FREEZE, R. ALLAN
THE MECHANISM OF NATURAL GROUND-WATER RECHARGE AND DISCHARGE 1. ONE-DIMENSIONAL, VERTICAL, UNSTEADY, UNSATURATED FLOW ABOVE A RECHARGING OR DISCHARGING GROUND-WATER FLOW SYSTEM,
W69-05436 02F

FRENCH, O. F.
WATER MANAGEMENT OF FALL-PLANTED SUGAR BEETS IN SALT RIVER VALLEY OF ARIZONA,
W69-05279 03F

FRERE, M. H.
HYDRAULIC CONDUCTIVITY RELATED TO POROSITY AND SWELLING OF SOIL,
W69-05443 02G

FREY, JOHN C.
A DISCUSSION OF DATA SYSTEMS AND INFORMATION RETRIEVAL ADAPTABLE TO WATER RESOURCES,
W69-05491 06B

FRIEDMAN, B. A.
IDENTIFICATION OF ZOOGLOEA SPECIES AND THE RELATIONSHIP TO ZOOGLOEAL MATRIX AND FLOC FORMATION,
W69-05313 05C

GARCIA, R. H.
MOISTURE-RETENTION CAPACITY OF LITTER UNDER TWO ARIZONA CHAPARRAL COMMUNITIES,
W69-05267 02G

GARDNER, J. P.
THE ECONOMICS OF WATER ALLOCATION IN UTAH,
W69-05507 06D

GENTILE, JOHN H.
DEMONSTRATION OF A TOXIN FROM APHANIZOMENON FLOS-AQUAE (L.) RALFS,
W69-05306 05C

GILL, JAMES

THE COMPETITION FOR WATER QUALITY INDUSTRY,
W69-05526 05G

GLADWELL, JOHN S.
FOURTH ANNUAL REPORT OF THE STATE OF WASHINGTON WATER RESEARCH CENTER, 1968.
W69-05322 09D

GLOYNA, EARNEST F.
MAJOR RESEARCH PROBLEMS IN WATER QUALITY,
W69-05519 05G

GOODIER, LESLIE J.
OFFSHORE PROSPECTING AND MINING LAWS OF THE UNITED STATES,
W69-05340 06E

GRANGER, C. W. J.
THE TYPICAL SPECTRAL SHAPE OF AN ECONOMIC VARIABLE,
W69-05522 06D

GRAVES, G. W.
WATER POLLUTION CONTROL USING BY-PASS PIPING,
W69-05503 05G

GRAY, MACK H., III.
UNSTEADY FLOW PARAMETERS IN HYDRAULIC DESIGN,
W69-05408 08B

GRILICHES, ZVI
DISTRIBUTED LAGS A SURVEY,
W69-05514 06B

GROZIER, RICHARD U.
RAFT FOR EVAPORATION-MEASUREMENT EQUIPMENT,
W69-05252 07B

HAGEN, J. I.
STUDIES OF METHODS OF SOIL WATER DETERMINATION,
W69-05305 02G

HAIGH, F. B.
WATER RESOURCES OF THE BURNETT REGION,
W69-05423 02E

HALDERMAN, ALLAN D.
MEASUREMENT OF SMALL SURFACE DISPLACEMENTS INDUCED BY FLUID FLOW,
W69-05433 02F

HALLER, FAYE M.
USING ANALYTICAL METHODS TO DEVELOP A SURFACE-RUNOFF MODEL,
W69-05431 02A

HALL, M. J.
DESIGN CRITERIA FOR LABORATORY CATCHMENT EXPERIMENTS, WITH PARTICULAR REFERENCE TO RAINFALL SIMULATION,
W69-05234 02A

HANNAN, E. J.
TESTING FOR SERIAL CORRELATION AFTER LEAST SQUARES REGRESSION,
W69-05289 06B

HANSEN, W. LEE
AN INCOME-NET WORTH APPROACH TO MEASURING ECONOMIC WELFARE,
W69-05290 06B

HARKNESS, JON P.
LONG SWINGS,
W69-05498 06B

HARRISON, D. S.
COMMON AQUATIC WEEDS,
W69-05446 02I

HARRIS, MARSHALL
LEGAL ASPECTS OF THE SMALL WATERSHED PROGRAM IN IOWA,
W69-05339 04D

HARTMAN, MONROE A.
RUNOFF VOLUME PREDICTION FROM DAILY CLIMATIC DATA,
W69-05426 02A

HART, WILLIAM E.
PREDICTING FIELD DISTRIBUTIONS OF SPRINKLER SYSTEMS,
W69-05285 03F

HASLER, A. D.
BIOLOGICAL ASPECTS OF EUTROPHICATION IN LAKES MENDOTA, CRYSTAL, TROUT AND GREEN,
W69-05324 02H

HATFIELD, G. B.
WATER POLLUTION CONTROL USING BY-PASS PIPING,
W69-05503 05G

HAUSER, VICTOR L.
QUALITY OF WATERS FROM PLAYAS ON THE SOUTHERN HIGH PLAINS,
W69-05276 03C

HEEDE, BURCHARD H.
ENGINEERING TECHNIQUES AND PRINCIPLES APPLIED TO SOIL EROSION CONTROL,
W69-05333 04D

HEWLETT, JOHN D.
IN DEFENSE OF EXPERIMENTAL WATERSHEDS,
W69-05405 02A

HILALY, HABIL
WATER WAVES OVER A RECTANGULAR CHANNEL THROUGH A REEF,
W69-05448 02L

HILER, EDWARD A.
PREDICTION OF SEDIMENT PROFILES IN OPEN CHANNEL FLOW BY TURBULENT DIFFUSION THEORY,
W69-05403 02J

HILL, I. K.
RUNOFF HYDROGRAPH AS A FUNCTION OF RAINFALL EXCESS,
W69-05438 02A

HINES, WILLIAM W.
LEGAL ASPECTS OF THE SMALL WATERSHED PROGRAM IN IOWA,
W69-05339 04D

HITCHON, BRIAN
FLUID FLOW IN THE WESTERN CANADA SEDIMENTARY BASIN - 1. EFFECT OF TOPOGRAPHY,
W69-05451 02F

HITE, HOWARD E., JR.
STUDIES ON METHODS OF SOIL WATER DETERMINATION,
W69-05304 02G

HOLM, PAUL L.
DATA SYSTEMS AND INFORMATION RETRIEVAL ADAPTABLE TO WATER RESOURCES,
W69-05490 06B

HOWELLS, DAVID H.
PROCEEDINGS OF SYMPOSIUM ON BETTER WATER AND SEWER SERVICES FOR SMALL COMMUNITIES IN NORTH CAROLINA,
W69-05424 06B

HUGHES, LEON S.
USE OF CARBON DIOXIDE IN BUBBLE GAGES TO PREVENT PRECIPITATION OF CALCIUM CARBONATE,
W69-05247 07B

HULL, ROBERT W.
THE ORIGIN AND DEVELOPMENT OF THE WATERWAYS POLICY OF THE UNITED STATES,
W69-05338 04A

HULL, WILLIAM J.
THE ORIGIN AND DEVELOPMENT OF THE WATERWAYS POLICY OF THE UNITED STATES,
W69-05338 04A

IRWIN, WILLIAM H.
WATER QUALITY IN IMPOUNDMENTS AND MODIFICATIONS FROM DESTRATIFICATION,
W69-05467 02H

JAMSHA, J. DEAN
DISCUSSION OF REGIONAL ECONOMIC DEVELOPMENT AND WATER,
W69-05489 06B

JENNINGS, M. E.
FREQUENCY CURVES FOR ANNUAL FLOOD SERIES WITH SOME ZERO EVENTS OR INCOMPLETE DATA,
W69-05455 07C

JOHNSON, A. I.
AN OUTLINE OF GEOPHYSICAL LOGGING METHODS AND THEIR USES IN HYDROLOGIC STUDIES,
W69-05261 07B

JOHNSON, H. B.
STATISTICAL ANALYSIS OF GROUND WATER USE AND REPLENISHMENT,
W69-05475 02F

JOHNS, B.
ON THE REPRESENTATION OF THE REYNOLDS STRESS IN A TIDAL ESTUARY,
W69-05213 02L

JORGENSON, DALE W.
RATIONAL DISTRIBUTED LAG FUNCTIONS,
W69-05515 06B

JOYNER, B. F.
SAMPLING APPARATUS TO MINIMIZE AERATION OF WATER FOR THE DETERMINATION OF DISSOLVED GASES,
W69-05246 07B

KALMA, J. D.
AN ACCURATE SMALL ORIFICE RAIN GAGE,
W69-05404 07B

KARASEN, I. F.
PROBLEMS OF THE METHODS AND ACCURACY OF HYDROLOGIC OBSERVATIONS (RUSSIAN),
W69-05210 07A

KARDOS, L. T.
EFFECT OF MOISTURE REGIMES AND HARVESTS ON EFFICIENCY OF WATER USE BY TEN FORAGE CROPS,
W69-05268 02I

KARPLUS, WALTER J.
IDENTIFICATION OF NONLINEAR PARAMETERS OF GROUND WATER BASINS BY HYBRID COMPUTATION,
W69-05271 02F

KAWAHARA, FRED K.
IDENTIFICATION AND DIFFERENTIATION OF HEAVY RESIDUAL OIL AND ASPHALT POLLUTANTS IN SURFACE WATERS BY COMPARATIVE RATIOS OF INFRARED ABSORBANCES,
W69-05421 05A

KELLY, T. E.
MINIMUM AND MAXIMUM WATER-LEVEL RECORDING DEVICES,
W69-05250 07B

KEMPER, W. D.
MOVEMENT OF WATER AND SALT THROUGH A CLAY-WATER SYSTEM EXPERIMENTAL VERIFICATION OF ONSAGER RECIPROCAL RELATION,
W69-05441 02G

THE EFFECT OF OSMOTIC PRESSURE GRADIENTS ON WATER MOVEMENT IN UNSATURATED SOIL,
W69-05442 02G

KEUP, LOWELL E.
PHOSPHORUS IN FLOWING WATERS,
W69-05445 05B

KLEVORICK, ALVIN K.
A NOTE ON THE DUAL PRICES OF INTEGER PROGRAMS,
W69-05523 06C

KLOCK, G. O.
PORE SIZE DISTRIBUTIONS AS MEASURED BY THE MERCURY INTRUSION METHOD AND THEIR USE IN PREDICTING PERMEABILITY,
W69-05439 02G

KNIPLING, EDWARD B.
ISOPIESTIC TECHNIQUE FOR MEASURING LEAF WATER POTENTIALS WITH A THERMOCOUPLE PSYCHROMETER,
W69-05286 02I

KNISEL, WALTER G., JR.
RUNOFF VOLUME PREDICTION FROM DAILY CLIMATIC DATA,
W69-05426 02A

KNOP, E.
LARGE TREATMENT PLANTS OF THE EMSCHER ASSOCIATION AND THEIR IMPORTANCE FOR IMPROVING CONDITIONS OF THE RHINE,
W69-05218 05D

KOROSI, ALEX
BASIC STUDIES OF SCALE CONTROL,
W69-05334 03A

KOSTENBADER, PAUL D.
TREATING COKE PLANT WASTE,
W69-05422 05D

KOUZNETZOV, A. S.
STUDIES OF RUNOFF FORMATION UNDER CONDITION OF HIGH-ANGLE ATTITUDE OF THE IMPERVIOUS BED,
W69-05229 02E

KRISHNAN, M. S.
KOYNA EARTHQUAKE OF DECEMBER 11, 1967,
W69-05419 08E

KUNKLER, J. L.
FIELD KIT FOR DETERMINING ALKALINITY,
W69-05243 07B

LADEWIG, J. E.
WATER RESOURCES OF THE BURNETT REGION,
W69-05423 02E

LAGERWERFF, J. V.
HYDRAULIC CONDUCTIVITY RELATED TO POROSITY AND SWELLING OF SOIL,
W69-05443 02G

LANE, CHARLES, E., JR.
RESERVOIR FISHERY RESOURCES,
W69-05463 02H

LARSON, E. E.
GRANITES, GRUSSES, AND THE SHERMAN EROSION SURFACE, SOUTHERN LARAMIE RANGE, COLORADO-WYOMING,
W69-05211 02J

LARSON, F. C.
WATER QUALITY INVESTIGATION, PART 1 - BASIC DATA, FORT LOUDOUN RESERVOIR, APRIL 1966 - JUNE 1968,
W69-05416 05A

LARSON, LEE W.
COMPUTERIZED SYSTEM FOR WYOMING SURFACE WATER RECORDS,
W69-05326 02E

LAWRENCE, J. M.
DYNAMICS OF PHYSICOCHEMISTRY IN A LARGE RESERVOIR,
W69-05466 02H

LEACH, C. E.
OIL SPILLAGE STUDY, LITERATURE SEARCH, AND CRITICAL EVALUATION FOR SELECTION OF PROMISING TECHNIQUES TO CONTROL AND PREVENT DAMAGE,
W69-05262 05G

LEHMAN, OLIVER R.
QUALITY OF WATERS FROM PLAYAS ON THE SOUTHERN HIGH PLAINS,
W69-05276 03C

LETEY, J.
MOVEMENT OF WATER AND SALT THROUGH A CLAY-WATER SYSTEM EXPERIMENTAL VERIFICATION OF ONSAGER RECIPROCAL RELATION,
W69-05441 02G

THE EFFECT OF OSMOTIC PRESSURE GRADIENTS ON WATER MOVEMENT IN UNSATURATED SOIL,
W69-05442 02G

LEVIN, A. G.
STUDIES OF RUNOFF FORMATION UNDER CONDITION OF HIGH-ANGLE ATTITUDE OF THE IMPERVIOUS BED,
W69-05229 02E

LEVI, DONALD R.
A LAWYER LOOKS AT WATER RESOURCE ECONOMICS,
W69-05292 06E

LICHTY, R. W.
RAINFALL-RUNOFF MODEL FOR SMALL BASIN FLOOD HYDROGRAPH SIMULATION,
W69-05420 02A

LIGGETT, F. E.
FLAT CHANNEL TERRACES,
W69-05282 02J

LOELTZ, O. J.
WATER-MANOMETER-AIR-LINE ASSEMBLY FOR DETERMINING DEPTH TO WATER IN WELLS,
W69-05249 07B

LOFTING, EVERARD M.
THE INTERINDUSTRY FACTOR-CONTEXT MATRIX AN APPLICATION FOR THE ANALYSIS AND PROJECTION OF REGIONAL WATER REQUIREMENTS,
W69-05509 06B

LOMAS, J.
AN ACCURATE SMALL ORIFICE RAIN GAGE,
W69-05404 07B

LONGENECKER, D. E.
VARIABLE ROW SPACING OF IRRIGATED COTTON AS A MEANS FOR REDUCING PRODUCTION COSTS AND CONSERVING WATER,
W69-05277 03F

LORD, WILLIAM B.
DISCUSSION OF WATER RESOURCE DEVELOPMENT PUBLIC AND PRIVATE INVESTMENT,
W69-05487 06B

LOTSPEICH, FREDERICK B.
QUALITY OF WATERS FROM PLAYAS ON THE SOUTHERN HIGH PLAINS,
W69-05276 03C

LOVELL, MICHAEL C.
MONEY, MULTIPLIER ACCELERATOR INTERACTION AND THE BUSINESS CYCLE,
W69-05291 06B

LUECK, B. F.
COMPONENTS OF WOOD PULP BLEACH EFFLUENTS,
W69-05402 05A

LULL, HOWARD W.
IN DEFENSE OF EXPERIMENTAL WATERSHEDS,
W69-05405 02A

LUTHIN, JAMES N.
COMPUTER METHODS FOR TRANSIENT ANALYSIS OF WATER-TABLE AQUIFERS,
W69-05435 07C

LU, CHIN H.
BASIC STUDIES OF SCALE CONTROL,
W69-05334 03A

LYERLY, P. J.
VARIABLE ROW SPACING OF IRRIGATED COTTON AS A MEANS FOR REDUCING PRODUCTION COSTS AND CONSERVING WATER,
W69-05277 03F

MACAU VILAR, FEDERICO
DETERMINATION OF FRESH WATERS IN THE CALCAREOUS MASSIF OF 'COSTA BRAVA', SPAIN (FRENCH),
W69-05474 02F

MACKENTHUN, K. M.
WRITING A WATER QUALITY REPORT,
W69-05212 10

MACPHEE, CRAIG
A LETHAL INDEX FOR CLASSIFYING CHEMICALS WHICH AFFECT WATER QUALITY OF AQUATIC LIFE,
W69-05303 05C

MAKI, WILBUR R.
REGIONAL ECONOMIC DEVELOPMENT AND WATER,
W69-05488 06B

MALAHOFF, A.
EVALUATION OF SOME GEOPHYSICAL TECHNIQUES APPLIED TO THE ENVIRONMENT OF A MAUI WELL,
W69-05418 02F

MANDELBROT, BENOIT B.
COMPUTER EXPERIMENTS WITH FRACTIONAL GAUSSIAN NOISES, PARTS 1, 2, AND 3,
W69-05453 07C

MANNERING, J. V.
TILLAGE METHODS TO REDUCE RUNOFF AND EROSION IN THE CORN BELT,
W69-05330 03F

RELATION OF SOIL PROPERTIES TO ITS ERODIBILITY,
W69-05444 02J

MANN, H. O.
EFFECT OF FATTY ALCOHOL ON CHANGE IN SOIL WATER DURING THE

SUMMER FALLOW PERIOD,
W69-05284 02G

MASSEY, DEAN T.
REGIONAL RESEARCH IN WATER IN THE NORTH CENTRAL REGION,
W69-05478 06B

MATHRANI, K. P.
ECONOMICS AND FINANCING OF IRRIGATION PROJECTS,
W69-05221 06C

MATSON, ARTHUR J.
DISCUSSION OF WATER ALLOCATION SUPPLY AND DEMAND RELATIONSHIPS,
W69-05485 06B

MCCLYMONDS, N. E.
HYDROLOGIC EFFECTS OF THE 1962-66 DROUGHT ON LONG ISLAND, N. Y.,
W69-05411 02A

MCCOY, E.
NITROGEN CYCLE IN SURFACE AND SUBSURFACE WATERS,
W69-05323 05B

MCDONOUGH, MARTIN
LEGAL CONSTRAINTS IN WATER PRICING POLICY,
W69-05493 06C

MCGAUKEY, P. H.
QUALITY WATER'S FOURTH DIMENSION,
W69-05524 05G

MCGILCHRIST, C. A.
RECURRENCE INTERVALS BETWEEN EXCEEDANCES OF SELECTED RIVER LEVELS. 2. ALTERNATIVES TO A MARKOV MODEL,
W69-05454 02E

MCKELL, C. M.
DROUGHT AND PHOSPHORUS AFFECT GROWTH OF ANNUAL FORAGE LEGUMES,
W69-05264 02I

MCKINNEY, ROSS E.
WATER QUALITY CHANGES IN CONFINED HOG WASTE TREATMENT,
W69-05417 05D

MCMICHAEL, FRANCIS C.
ARTIFICIAL MIXING OF DENSITY-STRATIFIED FLUIDS A LABORATORY INVESTIGATION,
W69-05412 02H

MEIER, W. L., JR.
OPTIMIZATION METHODS FOR BRANCHING MULTISTAGE WATER RESOURCE SYSTEMS--A REPLY TO A COMMENT BY E. F. BRATER,
W69-05501 06A

MERVA, GEORGE E.
A PROPOSED MECHANICS FOR THE INVESTIGATION OF SURFACE RUNOFF FROM SMALL WATERSHEDS. 1, DEVELOPMENT,
W69-05425 02A

METZLER, DWIGHT F.
ROLE OF STATE GOVERNMENTS IN U. S. WATER MANAGEMENT,
W69-05293 06E

MICKELSON, ROME H.
RUNOFF WATER-SPREADING ON LEVELED CROPLAND,
W69-05275 04A

MIDDLETON, T. E.
BASIC STUDIES OF SCALE CONTROL,
W69-05334 03A

MILLER, E. M.
FLOODS IN VIRGINIA - MAGNITUDE AND FREQUENCY,
W69-05415 02E

MOOLANI, M. K.
STUDIES ON WATER USE IN PEA (PISUM SATIVUM L.),
W69-05287 03F

MOORE, DONALD O.
WATER-RESOURCES APPRAISAL OF THE SNAKE RIVER BASIN IN NEVADA,
W69-05414 02E

MOURIN, V.
SALT WATER ENCROACHMENT IN KARST AQUIFERS, ISLAND OF KEPHALLINIA, (IONIAN),
W69-05472 02L

MURTHI, M. G. K.
KOYNA EARTHQUAKE OF DECEMBER 11, 1967,
W69-05419 08E

MUSICK, JACK
RUNOFF WATER-SPREADING ON LEVELED CROPLAND,
W69-05275 04A

NAKAYAMA, F. S.
HYDRAULIC CONDUCTIVITY RELATED TO POROSITY AND SWELLING OF SOIL,
W69-05443 02G

NATH, S. K.
WELFARE ECONOMICS, ECONOMIC GROWTH AND THE CHOICE OF TECHNIQUES,
W69-05500 06B

NEAL, JOE KENDALL
RESERVOIR EUTROPHICATION AND DYSTROPHICATION FOLLOWING IMPOUNDMENT,
W69-05471 02H

NERLOVE, MARC
USE OF THE DURBIN-WATSON STATISTIC IN INAPPROPRIATE SITUATIONS,
W69-05516 06D

NEUMAN, SHLOMO P.
TRANSIENT FLOW OF GROUND WATER TO WELLS IN MULTIPLE-AQUIFER SYSTEMS,
W69-05413 02F

NICOLSON, J. A.
THE INTERCEPTION-TRANSPIRATION RELATIONSHIP OF WHITE SPRUCE AND WHITE PINE,
W69-05274 02D

NIELSON, LYMAN H.
EVALUATION OF PRE-IMPOUNDMENT CONDITIONS FOR PREDICTION OF STORED WATER QUALITY,
W69-05468 02H

NIELSON, R. F.
EFFECT OF EARLY-SUMMER SEEDING OF WINTER WHEAT ON YIELD, SOIL MOISTURE, AND SOIL NITRATE,
W69-05280 03F

NOONAN, L.
THE EFFECT OF OSMOTIC PRESSURE GRADIENTS ON WATER MOVEMENT IN UNSATURATED SOIL,
W69-05442 02G

NORDENSON, TOR J.
PREPARATION OF CO-ORDINATED PRECIPITATION, RUNOFF AND EVAPORATION MAPS,
W69-05337 02A

NORMAN, DENNIS
A LETHAL INDEX FOR CLASSIFYING CHEMICALS WHICH AFFECT WATER QUALITY OF AQUATIC LIFE,
W69-05303 05C

OLIVE, JOHN H.
DEVELOPMENT OF BIOLOGICAL INDICES TO POLLUTION LEVELS IN STREAMS AFFECTED BY ACID MINE DRAINAGE AND OIL FIELD BRINE WASTES,
W69-05407 05A

OZBUN, J. L.
EFFECTS OF MOISTURE AND FERTILIZER ON YIELDS OF SPRING WHEAT AND BARLEY,
W69-05263 02I

O'BRIEN, MORROUGH P.
EQUILIBRIUM FLOW AREAS OF INLETS ON SANDY COASTS,
W69-05447 02L

O'SHEA, J. A.
WATER RESOURCES OF THE BURNETT REGION,
W69-05423 02E

PARSONS, T. R.
A CONTINUOUS SIZE SPECTRUM FOR PARTICULATE MATTER IN THE SEA,
W69-05529 07C

PASE, C. P.
MOISTURE-RETENTION CAPACITY OF LITTER UNDER TWO ARIZONA CHAPARRAL COMMUNITIES,
W69-05267 02G

PATRIC, J. H.
HYDROLOGY OF A SLIDE-PRONE GLACIAL TILL SOIL IN SOUTHEAST ALASKA,
W69-05406 02G

PAULSON, RICHARD W.
THE LONGITUDINAL DIFFUSION COEFFICIENT IN THE DELAWARE RIVER ESTUARY AS DETERMINED FROM A STEADY-STATE MODEL,
W69-05428 02L

PETERSON, FRANK L.
MEASUREMENT OF SMALL SURFACE DISPLACEMENTS INDUCED BY FLUID FLOW,
W69-05433 02F

PILLSBURY, ARTHUR F.
PROCEEDINGS WATER POLICY PRICING CONFERENCE,
W69-05492 06C

PINCOCK, M. GLADE
ASSESSING IMPACTS OF DECLINING WATER QUALITY ON GROSS VALUE OUTPUT OF AGRICULTURE, A CASE STUDY,
W69-05273 03C

PIONKE, H. B.
DETERMINATION OF ORGANOCHLORINE INSECTICIDES IN SOILS AND WATERS,
W69-05325 05A

PITTERMAN, MARVIN
A STUDY OF THE EFFECT OF TAXATION ON THE SIX PRIVATE OR QUASI-MUNICIPAL WATER UTILITIES IN RHODE ISLAND,
W69-05316 06C

POLKOWSKI, L. B.
NITROGEN CYCLE IN SURFACE AND SUBSURFACE WATERS,
W69-05323 05B

POWELL, R. D.
EFFECT OF MOISTURE REGIMES AND HARVESTS ON EFFICIENCY OF WATER USE BY TEN FORAGE CROPS,
W69-05268 02I

PRESCOTT, EDWARD
MONEY, MULTIPLIER ACCELERATOR INTERACTION AND THE BUSINESS CYCLE,
W69-05291 06B

PRINCE, R. G. H.
WATER RESOURCES OF THE BURNETT REGION,
W69-05423 02E

QUERIO, C. W.
VARIATION IN THE COMPOSITION OF BRINE FROM THE SYLVANIA FORMATION NEAR MIDLAND, MICHIGAN,
W69-05401 02F

RABE, FRED W.
LIMNOLOGICAL STUDIES OF LENTIC WATERS,
W69-05302 02H

RAGAN, ROBERT M.
AN EXPERIMENTAL INVESTIGATION OF PARTIAL AREA CONTRIBUTIONS,
W69-05227 02A

RANDLES, CHESTER
THE MICROBIAL FLORA OF ACID MINE WATER AND ITS RELATIONSHIP TO FORMATION AND REMOVAL OF ACID,
W69-05314 05G

RANTZ, S. E.
CHARACTERISTICS OF LOGARITHMIC RATING CURVES,
W69-05259 07B

INTERPRETATION OF FLOOD-FREQUENCY DATA,
W69-05260 07B

RAO, K. L.
KOYNA EARTHQUAKE OF DECEMBER 11, 1967,
W69-05419 08E

RAWSON, JACK
FIELD MONITORING OF THE QUALITY OF WATER DURING THE DRILLING OF WELLS,
W69-05245 07B

RAYNER, A. C.
EFFECT OF THE LENGTH OF THE TIME PERIOD ON SERIAL CORRELATION,
W69-05506 06D

RAY-CHAUDHURI, D. K.
AN ALTERNATIVE PROOF OF HANNAN'S THEOREM ON CANONICAL CORRELATION AND MULTIPLE EQUATION SYSTEMS,
W69-05511 06D

RECHARD, PAUL A.
COMPUTERIZED SYSTEM FOR WYOMING SURFACE WATER RECORDS,
W69-05326 02E

REIMER, CHARLES W.
A LIMNOLOGICAL RECONNAISSANCE OF AN IMPOUNDMENT RECEIVING HEAVY METALS WITH EMPHASIS OF DIATOMS AND FISH,
W69-05465 02H

REINHART, KENNETH G.
IN DEFENSE OF EXPERIMENTAL WATERSHEDS,
W69-05405 02A

RENNE, ROLAND R.
DISCUSSION OF REGIONAL RESEARCH IN THE NORTH CENTRAL REGION,
W69-05479 06B

RICHARDS, T. L.
HYDROMETEOROLOGICAL STUDIES IN SUPPORT OF THE INTERNATIONAL FIELD YEAR FOR THE GREAT LAKES,
W69-05222 02B

ROBBINS, WALLACE D.
USE OF CARBON DIOXIDE IN BUBBLE GAGES TO PREVENT PRECIPITATION OF CALCIUM CARBONATE,
W69-05247 07B

ROBECK, GORDON G.
WATER QUALITY IN IMPOUNDMENTS AND MODIFICATIONS FROM DESTRATIFICATION,
W69-05467 02H

ROCKAWAY, J. D.
STATISTICAL ANALYSIS OF GROUND WATER USE AND REPLENISHMENT,
W69-05475 02F

ROLLINS, M. B.
SOIL PROBLEMS IN RESEEDING A GREASEWOOD-RABBITBRUSH RANGE SITE,
W69-05269 02G

ROMANOV, V. V.
EVAPORATION FROM BOGS IN THE EUROPEAN TERRITORY OF THE USSR,
W69-05214 02D

ROSE, GORDON D.
REGIONAL RESEARCH IN WATER IN THE NORTH CENTRAL REGION,
W69-05478 06B

SASNER, JOHN J., JR.
DEMONSTRATION OF A TOXIN FROM APHANIZOMENON FLOS-AQUAE (L.) RALFS,
W69-05306 05C

SAUER, V. B.
POLAR COORDINATE CHART READER FOR STAGE-RAINFALL RECORDER,
W69-05254 07B

SAWHNEY, J. S.
STUDIES ON WATER USE IN PEA (PISUM SATIVUM L.),
W69-05287 03F

SAWYER, PHILIP J.
DEMONSTRATION OF A TOXIN FROM APHANIZOMENON FLOS-AQUAE (L.) RALFS,
W69-05306 05C

SCHMID, A. ALLAN
WATER RESOURCE DEVELOPMENT PUBLIC AND PRIVATE INVESTMENT,
W69-05486 06B

SCHULTZ, ROBERT P.
SOIL OR FOLIAR FERTILIZATION OF WELL-DRAINED AND FLOODED SLASH PINE,
W69-05332 02G

SCHWAB, GLENN O.
A PROPOSED MECHANICS FOR THE INVESTIGATION OF SURFACE RUNOFF FROM SMALL WATERSHEDS. 1, DEVELOPMENT,
W69-05425 02A

SCOTT, JOHN T., JR.
FACTOR ANALYSIS AND REGRESSION,
W69-05517 06B

SHASHOUA, Y.
AN ACCURATE SMALL ORIFICE RAIN GAGE,
W69-05404 07B

SHELDON, R. W.
A CONTINUOUS SIZE SPECTRUM FOR PARTICULATE MATTER IN THE SEA,
W69-05529 07C

SHIPMAN, HAROLD R.
WATER SUPPLY PROBLEMS IN DEVELOPING COUNTRIES,
W69-05513 03D

SIPLE, GEORGE E.
SALT-WATER ENCROACHMENT OF TERTIARY LIMESTONE ALONG COASTAL SOUTH CAROLINA,
W69-05473 02L

SKINNER, JOHN V.
VARIABLE-SPEED POWER EQUIPMENT FOR DEPTH-INTEGRATION SEDIMENT SAMPLING,
W69-05257 07B

SLACK, KEITH V.
A MICROKIT FOR DISSOLVED OXYGEN DETERMINATION,
W69-05242 07B

SMERDON, ERNEST T.
PREDICTION OF SEDIMENT PROFILES IN OPEN CHANNEL FLOW BY TURBULENT DIFFUSION THEORY,
W69-05403 02J

SMITH, STEPHEN C.
ECONOMIC ALTERNATIVES,
W69-05528 05G

SMOOT, GEORGE F.
WATER-STAGE AND RAINFALL DUAL RECORDER,
W69-05253 07B

SOMMER, ROBERT E., JR.
ELECTRIC CONTROL SYSTEM FOR DUAL OPERATION OF CURRENT METER AND SUSPENDED-SEDIMENT SAMPLER,
W69-05258 07B

STAHL, JANOS
INCREASING OR DECREASING RETURNS TO SCALE IN THE CONSTANT ELASTICITY OF SUBSTITUTION PRODUCTION FUNCTION,
W69-05505 06D

STEVENS, HERBERT H., JR.
ELECTRIC CONTROL SYSTEM FOR DUAL OPERATION OF CURRENT METER AND SUSPENDED-SEDIMENT SAMPLER,
W69-05258 07B

STEWART, ROBERT L.
POLYETHYLENE OIL TUBES FOR STILLING WELLS,
W69-05248 07B

STONER, J. D.
COMPARISON OF RESULTS USING THREE SAMPLING TECHNIQUES FOR A FLUOMETRIC DYE STUDY IN A STREAM,
W69-05239 07B

STREET, ROBERT L.
SHOALING OF SOLITARY WAVES ON SMALL SLOPES,
W69-05450 02H

SUCOFF, E. I.
THE INTERCEPTION-TRANSPIRATION RELATIONSHIP OF WHITE SPRUCE AND WHITE PINE,
W69-05274 02D

SURKAN, A. J.
SYNTHETIC HYDROGRAPHS EFFECTS OF NETWORK GEOMETRY,
W69-05432 02A

SUTCLIFFE, J. V.
THE ASSESSMENT OF RUNOFF FROM A MOUNTAINOUS AND SEMI-ARID

AREA IN WESTERN IRAN,
W69-05233 02E

SWANSTON, D. N.
HYDROLOGY OF A SLIDE-PRONE GLACIAL TILL SOIL IN SOUTHEAST ALASKA,
W69-05406 02G

SYMONS, JAMES M.
WATER QUALITY IN IMPOUNDMENTS AND MODIFICATIONS FROM DESTRATIFICATION,
W69-05467 02H

SZAKOLCZAI, GYORGY
INCREASING OR DECREASING RETURNS TO SCALE IN THE CONSTANT ELASTICITY OF SUBSTITUTION PRODUCTION FUNCTION,
W69-05505 06D

TAYLOR, GEORGE H. B.
THE TENNESSEE VALLEY AUTHORITY ECONOMIC IMPACT OF ITS COMPREHENSIVE WATER DEVELOPMENT PROGRAM,
W69-05502 06B

TAYLOR, GEORGE S.
COMPUTER METHODS FOR TRANSIENT ANALYSIS OF WATER-TABLE AQUIFERS,
W69-05435 07C

TAYLOR, ROBERT G.
PESTICIDE LEVELS AND FLUCTUATION IN SOIL BACTERIA IN AN IRRIGATED FIELD AND A POND OF SOUTHWEST TEXAS,
W69-05272 05C

TERRAGUCHI, M.
BIOLOGICAL ASPECTS OF EUTROPHICATION IN LAKES MENDOTA, CRYSTAL, TROUT AND GREEN,
W69-05324 02H

TERRELL, R. D.
TESTING FOR SERIAL CORRELATION AFTER LEAST SQUARES REGRESSION,
W69-05289 06B

THALLER, M.
AN ACCURATE SMALL ORIFICE RAIN GAGE,
W69-05404 07B

THAXTON, E. L., JR.
VARIABLE ROW SPACING OF IRRIGATED COTTON AS A MEANS FOR REDUCING PRODUCTION COSTS AND CONSERVING WATER,
W69-05277 03F

THOMAS, WILLIAM H.
EFFECTS OF PHOSPHATE CONCENTRATION ON CELL DIVISION RATES AND YIELD OF A TROPICAL OCEANIC DIATOM,
W69-05530 05C

THORUD, D. B.
THE INTERCEPTION-TRANSPIRATION RELATIONSHIP OF WHITE SPRUCE AND WHITE PINE,
W69-05274 02D

TIMMONS, JOHN F.
WATER ALLOCATION SUPPLY AND DEMAND RELATIONSHIPS,
W69-05483 06B

TUCKER, RUSSELL L.
USING ANALYTICAL METHODS TO DEVELOP A SURFACE-RUNOFF MODEL,
W69-05431 02A

TUNSTALL, B. R.
TISSUE WATER RELATIONS FOR BRIGALOW AND MULGA,
W69-05281 02I

VANDERLIP, R. L.
RELATIONSHIP OF PALMER DROUGHT VARIABLES TO YIELD OF WINTER WHEAT,
W69-05283 03F

VEMURI, VENKATESWARARAO
IDENTIFICATION OF NONLINEAR PARAMETERS OF GROUND WATER BASINS BY HYBRID COMPUTATION,
W69-05271 02F

VERDUIN, JACOB
RESERVOIR MANAGEMENT PROBLEMS CREATED BY INCREASED PHOSPHORUS LEVELS OF SURFACE WATERS,
W69-05470 02H

VISSER, W. C.
A METHOD OF DETERMINING EVAPOTRANSPIRATION IN SOIL MONOLITHS,
W69-05270 02D

WADIA, D. N.
KOYNA EARTHQUAKE OF DECEMBER 11, 1967,
W69-05419 08E

WALKER, WILLIAM R.
WATER RESOURCES LAW IN VIRGINIA.
W69-05533 06E

WATER RESOURCES LAWS IN VIRGINIA (NATURAL SURFACE WATERCOURSES).
W69-05534 06E

WATER RESOURCES LAWS IN VIRGINIA (PERCOLATING GROUNDWATER - DIFFUSED SURFACE WATER).
W69-05535 06E

WATER RESOURCES LAW IN VIRGINIA (OTHER WATER SOURCES).
W69-05536 06E

WATER RESOURCES LAW IN \IRGINIA (ARTIFICALLY CONFINED WATER).
W69-05537 02H

WATER RESOURCES LAWS IN VIRGINIA (REMEDIES FOR INFRINGEMENT OF WATER RIGHTS).
W69-05538 06E

WALKE, CLIFFORD L. R.
TECHNIQUES OF WATER MANAGEMENT OF LAKE OKEECHOBEE AND THE FLORIDA EVERGLADES,
W69-05223 04A

WALLIS, JAMES R.
COMPUTER EXPERIMENTS WITH FRACTIONAL GAUSSIAN NOISES, PARTS 1, 2, AND 3,
W69-05453 07C

WALLIS, KENNETH F.
USE OF THE DURBIN-WATSON STATISTIC IN INAPPROPRIATE SITUATIONS,
W69-05516 06D

WALL, J. P.
BIOLOGICAL ASPECTS OF EUTROPHICATION IN LAKES MENDOTA, CRYSTAL, TROUT AND GREEN,
W69-05324 02H

WATSON, D. G.
ACCUMULATION OF PHOSPHORUS-32 AND ZINC-65 BY LIVING AND KILLED PLANKTON,
W69-05531 05C

WEBB, A. A.
COMPONENTS OF WOOD PULP BLEACH EFFLUENTS,
W69-05402 05A

WEEKS, EDWIN P.
DETERMINING THE RATIO OF HORIZONTAL TO VERTICAL PERMEABILITY BY AQUIFER-TEST ANALYSIS,
W69-05452 02F

WEISBROD, BURTON A.
AN INCOME-NET WORTH APPROACH TO MEASURING ECONOMIC WELFARE,
W69-05290 06B

WELBORN, CLARENCE T.
VARIABLE-SPEED POWER EQUIPMENT FOR DEPTH-INTEGRATION SEDIMENT SAMPLING,
W69-05257 07B

WELDON, L. W.
COMMON AQUATIC WEEDS,
W69-05446 02I

WHINSTON, A.
WATER POLLUTION CONTROL USING BY-PASS PIPING,
W69-05503 05G

WHISLER, F. D.
ANALYZING STEADY-STATE FLOW IN AN INCLINED SOIL SLAB WITH AN ELECTRIC ANALOG,
W69-05440 02G

WILLIAMS, W. A.
DROUGHT AND PHOSPHORUS AFFECT GROWTH OF ANNUAL FORAGE LEGUMES,
W69-05264 02I

WILSON, A. M.
DROUGHT AND PHOSPHORUS AFFECT GROWTH OF ANNUAL FORAGE LEGUMES,
W69-05264 02I

WILSON, JAMES F., JR.
TIME-OF-TRAVEL MEASUREMENTS AND OTHER APPLICATIONS OF DYE TRACING,
W69-05228 07B

IMPROVED DYES FOR WATER TRACING,
W69-05235 07B

DYE-CLOUD PHOTOGRAPHY,
W69-05241 07B

WISCHMEIER, W. H.
RELATION OF SOIL PROPERTIES TO ITS ERODIBILITY,
W69-05444 02J

WISSMAR, ROBERT C.
LIMNOLOGICAL STUDIES OF LENTIC WATERS,
W69-05302 02H

WITHERSPOON, PAUL A.
TRANSIENT FLOW OF GROUND WATER TO WELLS IN MULTIPLE-AQUIFER SYSTEMS,
W69-05413 02F

WITZEL, S.
NITROGEN CYCLE IN SURFACE AND SUBSURFACE WATERS,
W69-05323 05B

WOLF, P. O.
DESIGN CRITERIA FOR LABORATORY CATCHMENT EXPERIMENTS, WITH PARTICULAR REFERENCE TO RAINFALL SIMULATION,
W69-05234 02A

WOODYER, K. D.
RECURRENCE INTERVALS BETWEEN EXCEEDANCES OF SELECTED RIVER

LEVELS. 2. ALTERNATIVES TO A MARKOV MODEL,
W69-05454 02E

WRIGHT, JOHN C.
EFFECT OF IMPOUNDMENTS ON PRODUCTIVITY, WATER CHEMISTRY, AND HEAT BUDGETS OF RIVERS,
W69-05469 02H

WUNDERLICH, W. O.
THE MECHANICS OF STRATIFIED FLOW IN RESERVOIRS,
W69-05464 02H

YONTS, WOODROW L., JR.
SERVOPSYCHROMETER,
W69-05251 07B

YOUNGMAN, VERN E.
SOIL MOISTURE CONDITIONS UNDER PASTURES OF COOL-SEASON AND WARM-SEASON GRASSES,
W69-05266 02G

YOUNG, R. A.
EFFECTS OF MOISTURE AND FERTILIZER ON YIELDS OF SPRING WHEAT AND BARLEY,
W69-05263 02I

YU, YUN-SHENG
UNSTEADY FLOW PARAMETERS IN HYDRAULIC DESIGN,
W69-05408 08B

ZOETL, J.
SALT WATER ENCROACHMENT IN KARST AQUIFERS, ISLAND OF KEPHALLINIA, (IONIAN),
W69-05472 02L

ORGANIZATIONAL INDEX

AGRICULTURAL RESEARCH SERVICE, AKRON, COLO. CENTRAL GREAT PLAINS FIELD STATION.
RUNOFF WATER-SPREADING ON LEVELED CROPLAND,
W69-05275 04A

AGRICULTURAL RESEARCH SERVICE, BELTSVILLE, MD. SOILS LAB. AND AGRICULTURAL RESEARCH SERVICE, PHOENIX, ARIZ. WATER CONSERVATION LAB.
HYDRAULIC CONDUCTIVITY RELATED TO POROSITY AND SWELLING OF SOIL,
W69-05443 02G

AGRICULTURAL RESEARCH SERVICE, BUSHLAND, TEX.
QUALITY OF WATERS FROM PLAYAS ON THE SOUTHERN HIGH PLAINS,
W69-05276 03C

AGRICULTURAL RESEARCH SERVICE, GAINESVILLE, FLA. CROPS RESEARCH DIV. AND FLORIDA UNIV., GAINESVILLE. AGRICULTURAL EXTENSION SERVICE.
COMMON AQUATIC WEEDS,
W69-05446 02I

AGRICULTURAL RESEARCH SERVICE, LAFAYETTE, IND. AND PURDUE UNIV., LAFAYETTE, IND. DEPT. OF AGRONOMY.
RELATION OF SOIL PROPERTIES TO ITS ERODIBILITY,
W69-05444 02J

AGRICULTURAL RESEARCH SERVICE, PHOENIX, ARIZ. WATER CONSERVATION LAB.
PUTTING WASTE WATER TO BENEFICIAL USE - THE FLUSHING MEADOWS PROJECT,
W69-05327 05D

RETURNING WASTES TO THE LAND, A NEW ROLE FOR AGRICULTURE,
W69-05328 05D

ANALYZING STEADY-STATE FLOW IN AN INCLINED SOIL SLAB WITH AN ELECTRIC ANALOG,
W69-05440 02G

AGRICULTURAL RESEARCH SERVICE, PULLMAN, WASH. RESEARCH DIV. CALIFORNIA UNIV., RIVERSIDE CALIFORNIA UNIV., DAVIS.
DROUGHT AND PHOSPHORUS AFFECT GROWTH OF ANNUAL FORAGE LEGUMES,
W69-05264 02I

AGRICULTURAL RESEARCH SERVICE, RIESEL, TEX. AND AGRICULTURAL RESEARCH SERVICE, CHICKASHA, OKLA.
RUNOFF VOLUME PREDICTION FROM DAILY CLIMATIC DATA,
W69-05426 02A

AGRICULTURAL RESEARCH SERVICE, WASHINGTON, D. C. SOIL AND WATER RESEARCH DIV., AGRICULTURAL RESEARCH SERVICE, WASHINGTON, D. C. CROPS RESEARCH DIV.
SOIL PROBLEMS IN RESEEDING A GREASEWOOD-RABBITBRUSH RANGE SITE,
W69-05269 02G

AGRICULTURAL RESEARCH SERVICE, WASHINGTON, D. C. PURDUE UNIV., LAFAYETTE, IND. AGRICULTURAL EXPERIMENT STATION.
TILLAGE METHODS TO REDUCE RUNOFF AND EROSION IN THE CORN BELT,
W69-05330 03F

AGRICULTURE RESEARCH SERVICE, PHOENIX, ARIZ. WATER CONSERVATION LABORATORY.
WATER MANAGEMENT OF FALL-PLANTED SUGAR BEETS IN SALT RIVER VALLEY OF ARIZONA,
W69-05279 03F

AMERICAN FISHERIES SOCIETY, NEW YORK.
RESERVOIR FISHERY RESOURCES,
W69-05463 02H

AMERICAN WATER RESOURCES ASSOCIATION, URBANA, ILL.
PROCEEDINGS OF THE THIRD ANNUAL AMERICAN WATER RESOURCES CONFERENCE.
W69-05508 06B

AUBURN UNIV., ALA. AGRICULTURAL EXPERIMENT STATION.
DYNAMICS OF PHYSICOCHEMISTRY IN A LARGE RESERVOIR,
W69-05466 02H

AUSTRALIAN NATIONAL UNIV., CANBERRA.
TESTING FOR SERIAL CORRELATION AFTER LEAST SQUARES REGRESSION,
W69-05289 06B

BATTELLE MEMORIAL INST., RICHLAND, WASH. PACIFIC NORTHWEST LABS.
OIL SPILLAGE STUDY, LITERATURE SEARCH, AND CRITICAL EVALUATION FOR SELECTION OF PROMISING TECHNIQUES TO CONTROL AND PREVENT DAMAGE,
W69-05262 05G

BATTELLE-NORTHWEST, RICHLAND, WASH. PACIFIC NORTHWEST LAB.
ACCUMULATION OF PHOSPHORUS-32 AND ZINC-65 BY LIVING AND KILLED PLANKTON,
W69-05531 05C

BETHLEHEM STEEL CORP., PA. HOMER RESEARCH LAB.
TREATING COKE PLANT WASTE,
W69-05422 05D

BIRMINGHAM UNIV. (ENGLAND).
AUTOCORRELATION BETWEEN FIRST DIFFERENCES OF MID-RANGES,
W69-05520 06B

CALIFORNIA UNIV., BERKELEY.
TRANSIENT FLOW OF GROUND WATER TO WELLS IN MULTIPLE-AQUIFER SYSTEMS,
W69-05413 02F

THE INTERINDUSTRY FACTOR-CONTEXT MATRIX AN APPLICATION FOR THE ANALYSIS AND PROJECTION OF REGIONAL WATER REQUIREMENTS,
W69-05509 06B

RATIONAL DISTRIBUTED LAG FUNCTIONS,
W69-05515 06B

QUALITY WATER'S FOURTH DIMENSION,
W69-05524 05G

ECONOMIC ALTERNATIVES,
W69-05528 05G

CALIFORNIA UNIV., BERKELEY. COLL. OF ENGINEERING.
EQUILIBRIUM FLOW AREAS OF INLETS ON SANDY COASTS,
W69-05447 02L

CALIFORNIA UNIV., DAVIS AND OHIO STATE UNIV., COLUMBUS.
COMPUTER METHODS FOR TRANSIENT ANALYSIS OF WATER-TABLE AQUIFERS,
W69-05435 07C

CALIFORNIA UNIV., DAVIS.
THE COMPETITION FOR WATER QUALITY AGRICULTURE,
W69-05525 05G

CALIFORNIA UNIV., DAVIS. DEPT. OF WATER SCIENCE AND ENGINEERING.
PREDICTING FIELD DISTRIBUTIONS OF SPRINKLER SYSTEMS,
W69-05285 03F

CALIFORNIA UNIV., DAVIS. LAB. OF PLANT-WATER RELATIONS.
STOMATAL OPENING IN ISOLATED EPIDERMAL STRIPS OF VICIA FABA. I. RESPONSE TO LIGHT AND TO CO2-FREE AIR,
W69-05278 02I

CALIFORNIA UNIV., LOS ANGELES.
IDENTIFICATION OF NONLINEAR PARAMETERS OF GROUND WATER BASINS BY HYBRID COMPUTATION,
W69-05271 02F

PROCEEDINGS WATER POLICY PRICING CONFERENCE,
W69-05492 06C

THE CONSUMER'S VIEWPOINT AND POLICY DECISIONS,
W69-05495 06C

CALIFORNIA UNIV., LOS ANGELES. GRADUATE SCHOOL OF BUSINESS AND PURDUE UNIV., LAFAYETTE, IND. KRANNERT GRADUATE SCHOOL.
WATER POLLUTION CONTROL USING BY-PASS PIPING,
W69-05503 05G

CALIFORNIA UNIV., RIVERSIDE COLORADO STATE UNIV., FORT COLLINS AND AGRICULTURAL RESEARCH SERVICE, WASHINGTON, D. C.
MOVEMENT OF WATER AND SALT THROUGH A CLAY-WATER SYSTEM EXPERIMENTAL VERIFICATION OF ONSAGER RECIPROCAL RELATION,
W69-05441 02G

CALIFORNIA UNIV., RIVERSIDE. DEPT. OF SOIL PHYSICS, AND COLORADO STATE UNIV., FORT COLLINS.
THE EFFECT OF OSMOTIC PRESSURE GRADIENTS ON WATER MOVEMENT IN UNSATURATED SOIL,
W69-05442 02G

CAMBRIDGE UNIV. (ENGLAND).
RUNOFF HYDROGRAPH AS A FUNCTION OF RAINFALL EXCESS,
W69-05438 02A

CANTERBURY UNIV., CHRISTCHURCH (NEW ZEALAND).
EFFECT OF THE LENGTH OF THE TIME PERIOD ON SERIAL CORRELATION,
W69-05506 06D

CARNEGIE-MELLON UNIV., PITTSBURGH, PA. PENNSYLVANIA UNIV., PHILADELPHIA.
MONEY, MULTIPLIER ACCELERATOR INTERACTION AND THE BUSINESS CYCLE,
W69-05291 06B

CASSA PER IL MEZZOGIORNO (ITALY).
THE FUNDAMENTAL ROLE OF WATER IN THE 'CASSA PER IL MEZZOGIORNO' DEVELOPMENT PROGRAMS FOR SOUTHERN ITALY,
W69-05216 06D

CATHOLIC UNIV. OF AMERICA, WASHINGTON, D. C.
COMPARATIVE STUDY OF SNOW TYPE HYDROLOGY OF NORTHEASTERN CANADA AND OF PLAINS OF RUSSIA AND SIBERIA,
W69-05225 02E

CHESTER COUNTY WATER RESOURCES AUTHORITY, WEST CHESTER, PA. AND PENNSYLVANIA UNIV., PHILADELPHIA. INST. FOR ENVIRONMENTAL STUDIES.
THE PLAN AND PROGRAM FOR THE BRANDYWINE.
W69-05299 06B

CHICAGO UNIV., ILL.
DISTRIBUTED LAGS A SURVEY,
W69-05514 06B

CITY OF SAN DIEGO, CALIF.

THE COMPETITION FOR WATER QUALITY DOMESTIC USE,
W69-05527 05G

COLORADO STATE UNIV., SPRINGFIELD. SOUTHEASTERN COLORADO BRANCH STATION.
EFFECT OF FATTY ALCOHOL ON CHANGE IN SOIL WATER DURING THE SUMMER FALLOW PERIOD,
W69-05284 02G

CORPS OF ENGINEERS, BALTIMORE, MD.
FLOOD PLAIN INFORMATION, SOUTHWEST BRANCH, PRINCE GEORGES COUNTY, MARYLAND.
W69-05203 04A

FLOOD PLAIN INFORMATION (ANACOSTIA RIVER), PRINCE GEORGES COUNTY, MARYLAND.
W69-05204 04A

CORPS OF ENGINEERS, BUFFALO, N. Y.
FLOOD PLAIN INFORMATION OF ELLICOTT CREEK IN CITY OF TONAWANDA AND VICINITY, ERIE COUNTY, NEW YORK.
W69-05458 02E

FLOOD PLAIN INFORMATION OF CATTARAUGUS CREEK, ARCADE, WYOMING COUNTY, NEW YORK.
W69-05462 02E

CORPS OF ENGINEERS, FORT WORTH, TEX.
FLOOD PLAIN INFORMATION OF DUCK CREEK, GARLAND, TEXAS.
W69-05459 02E

FLOOD PLAIN INFORMATION, SOUTH MESQUITE CREEK, MESQUITE, TEXAS.
W69-05460 02E

FLOOD PLAIN INFORMATION, TENMILE CREEK, DALLAS COUNTY, TEXAS.
W69-05461 02E

CORPS OF ENGINEERS, JACKSONVILLE, FLA. SOUTH ATLANTIC DIV.
TECHNIQUES OF WATER MANAGEMENT OF LAKE OKEECHOBEE AND THE FLORIDA EVERGLADES,
W69-05223 04A

CORPS OF ENGINEERS, MOBILE, ALA.
FLOOD PLAIN INFORMATION OF PROCTOR CREEK, METROPOLITAN ATLANTA, GEORGIA.
W69-05206 04A

CORPS OF ENGINEERS, SAVANNAH, GA.
FLOOD PLAIN INFORMATION, INTRENCHMENT, SUGAR, DOOLITTLE AND DOLESS CREEKS.
W69-05205 04A

FLOOD PLAIN INFORMATION ON HEADWATERS SOUTH RIVER, METROPOLITAN ATLANTA, GEORGIA.
W69-05207 04A

DEPARTMENT OF AGRICULTURE, WASHINGTON, D. C.
DATA SYSTEMS AND INFORMATION RETRIEVAL ADAPTABLE TO WATER RESOURCES,
W69-05490 06B

DEPT. OF ENERGY, MINES AND RESOURCES, CALGARY (ALBERTA). INLAND WATERS BRANCH.
THE MECHANISM OF NATURAL GROUND-WATER RECHARGE AND DISCHARGE 1. ONE-DIMENSIONAL, VERTICAL, UNSTEADY, UNSATURATED FLOW ABOVE A RECHARGING OR DISCHARGING GROUND-WATER FLOW SYSTEM,
W69-05436 02F

DEPT. OF THE INTERIOR, WASHINGTON, D. C.
DISCUSSION OF REGIONAL RESEARCH IN THE NORTH CENTRAL REGION,
W69-05479 06B

DOW CHEMICAL CO., MIDLAND, MICH.
VARIATION IN THE COMPOSITION OF BRINE FROM THE SILVANIA FORMATION NEAR MIDLAND, MICHIGAN,
W69-05401 02F

DUKE UNIV., DURHAM, N. C.
THE UTILITY OF DISASTERS,
W69-05288 06B

DUKE UNIV., DURHAM, N. C. DEPT. OF BOTANY.
ISOPIESTIC TECHNIQUE FOR MEASURING LEAF WATER POTENTIALS WITH A THERMOCOUPLE PSYCHROMETER,
W69-05286 02I

ECONOMIC RESEARCH SERVICE, SALT LAKE CITY, UTAH.
ASSESSING IMPACTS OF DECLINING WATER QUALITY ON GROSS VALUE OUTPUT OF AGRICULTURE, A CASE STUDY,
W69-05273 03C

EMSCHERGENOSSENSCHAFT, ESSEN (WEST GERMANY).
LARGE TREATMENT PLANTS OF THE EMSCHER ASSOCIATION AND THEIR IMPORTANCE FOR IMPROVING CONDITIONS OF THE RHINE,
W69-05218 05D

ETHYL CORP., PITTSBURG, CALIF.
THE COMPETITION FOR WATER QUALITY INDUSTRY,
W69-05526 05G

FAIRFAX COUNTY WATER AUTHORITY, ANNANDALE, VA.
COMPLETION OF THE FAIRFAX COUNTY WATER AUTHORITY ACQUISITION PROGRAM.
W69-05539 03D

FEDERAL COUNCIL FOR SCIENCE AND TECHNOLOGY, WASHINGTON, D. C.
WATER RESOURCES POLICY AND POLITICAL INSTITUTIONS.
W69-05295 06B

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, CINCINNATI, OHIO. BIOLOGICAL AND CHEMICAL SECTION.
WRITING A WATER QUALITY REPORT,
W69-05212 10

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, CINCINNATI, OHIO.
IDENTIFICATION AND DIFFERENTIATION OF HEAVY RESIDUAL OIL AND ASPHALT POLLUTANTS IN SURFACE WATERS BY COMPARATIVE RATIOS OF INFRARED ABSORBANCES,
W69-05421 05A

PHOSPHORUS IN FLOWING WATERS,
W69-05445 05B

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, CORVALLIS, OREG. PACIFIC NORTHWEST WATER LAB.
EVALUATION OF PRE-IMPOUNDMENT CONDITIONS FOR PREDICTION OF STORED WATER QUALITY,
W69-05468 02H

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, WHEELING, W. VA. OHIO BASIN REGION.
SOURCES OF COAL MINE DRAINAGE POLLUTION, WHEELING CREEK WATERSHED, OHIO.
W69-05202 05B

FISHERIES RESEARCH BOARD, NANAIMO (BRITISH COLUMBIA). PACIFIC OCEANOGRAPHIC GROUP.
A CONTINUOUS SIZE SPECTRUM FOR PARTICULATE MATTER IN THE SEA,
W69-05529 07C

FOREST SERVICE (USDA) JUNEAU, ALASKA. PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION.
HYDROLOGY OF A SLIDE-PRONE GLACIAL TILL SOIL IN SOUTHEAST ALASKA,
W69-05406 02G

FOREST SERVICE (USDA), ASHEVILLE, N. C. SOUTHEASTERN FOREST EXPERIMENT STATION FOREST SERVICE (USDA), MACON, GA. SOUTHERN FOREST FIRE LAB. NORTH CAROLINA DIV. OF FORESTRY.
SEASONAL AND DIURNAL VARIATION IN POCOSIN SHRUB MOISTURE CONTENT,
W69-05331 02I

FOREST SERVICE (USDA), BERKELEY, CALIF. PACIFIC SOUTHWEST FOREST AND RANGE EXPERIMENT STATION.
SNOW ACCUMULATION AS RELATED TO METEOROLOGICAL, TOPOGRAPHIC, AND FOREST VARIABLES IN CENTRAL SIERRA NEVADA, CALIFORNIA,
W69-05226 02C

FOREST SERVICE (USDA), FORT COLLINS, COLO. ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION.
ENGINEERING TECHNIQUES AND PRINCIPLES APPLIED TO SOIL EROSION CONTROL,
W69-05333 04D

FOREST SERVICE (USDA), OLUSTEE, FLA. NAVAL STORES AND TIMBER PRODUCTION LAB.
SOIL OR FOLIAR FERTILIZATION OF WELL-DRAINED AND FLOODED SLASH PINE,
W69-05332 02G

FRIED-KRUPP, ESSEN (WEST GERMANY). ZENTRALINSTITUT FUER FORSCHUNG UND ENTWICKLUNG.
PORTABLE WATER PURIFIERS FOR COSTA RICA,
W69-05456 05D

GEOLOGICAL SURVEY, ALBUQUERQUE, N. MEX.
TREATED WATERSHED YIELDS IMPROVED WATER HARVEST,
W69-05410 03B

GEOLOGICAL SURVEY, CARSON CITY, NEV.
WATER-RESOURCES APPRAISAL OF THE SNAKE RIVER BASIN IN NEVADA,
W69-05414 02E

GEOLOGICAL SURVEY, CHEYENNE, WYO. WATER RESOURCES DIVISION.
TIME-OF-TRAVEL MEASUREMENTS AND OTHER APPLICATIONS OF DYE TRACING,
W69-05228 07B

GEOLOGICAL SURVEY, COLUMBIA, S. C.
SALT-WATER ENCROACHMENT OF TERTIARY LIMESTONE ALONG COASTAL SOUTH CAROLINA,
W69-05473 02L

GEOLOGICAL SURVEY, MADISON, WIS.
DETERMINING THE RATIO OF HORIZONTAL TO VERTICAL PERMEABILITY BY AQUIFER-TEST ANALYSIS,
W69-05452 02F

GEOLOGICAL SURVEY, MENLO PARK, CALIF.
RAINFALL-RUNOFF MODEL FOR SMALL BASIN FLOOD HYDROGRAPH SIMULATION,
W69-05420 02A

GEOLOGICAL SURVEY, PHILADELPHIA, PA.
THE LONGITUDINAL DIFFUSION COEFFICIENT IN THE DELAWARE RIVER ESTUARY AS DETERMINED FROM A STEADY-STATE MODEL,
W69-05428 02L

GEOLOGICAL SURVEY, RICHMOND, VA.
FLOODS IN VIRGINIA - MAGNITUDE AND FREQUENCY,
W69-05415 02E

GEOLOGICAL SURVEY, WASHINGTON, D. C.
IMPROVED DYES FOR WATER TRACING,
W69-05235 07B

NOMOGRAPHS FOR DETERMINING AMOUNT OF RHODAMINE B DYE FOR TIME-OF-TRAVEL STUDIES,
W69-05236 07B

SELECTION OF DYE-INJECTION AND MEASURING SITES FOR TIME-OF-TRAVEL STUDIES,
W69-05238 07B

COMPARISON OF RESULTS USING THREE SAMPLING TECHNIQUES FOR A FLUOMETRIC DYE STUDY IN A STREAM,
W69-05239 07B

COMPARISON OF FLOOD-WAVE AND WATER-PARTICLE TRAVELTIMES,
W69-05240 02E

DYE-CLOUD PHOTOGRAPHY,
W69-05241 07B

A MICROKIT FOR DISSOLVED OXYGEN DETERMINATION,
W69-05242 07B

FIELD KIT FOR DETERMINING ALKALINITY,
W69-05243 07B

RAPID FIELD FILTRATION OF WATER SAMPLES,
W69-05244 07B

FIELD MONITORING OF THE QUALITY OF WATER DURING THE DRILLING OF WELLS,
W69-05245 07B

SAMPLING APPARATUS TO MINIMIZE AERATION OF WATER FOR THE DETERMINATION OF DISSOLVED GASES,
W69-05246 07B

USE OF CARBON DIOXIDE IN BUBBLE GAGES TO PREVENT PRECIPITATION OF CALCIUM CARBONATE,
W69-05247 07B

POLYETHYLENE OIL TUBES FOR STILLING WELLS,
W69-05248 07B

WATER-MANOMETER-AIR-LINE ASSEMBLY FOR DETERMINING DEPTH TO WATER IN WELLS,
W69-05249 07B

MINIMUM AND MAXIMUM WATER-LEVEL RECORDING DEVICES,
W69-05250 07B

SERVOPSYCHROMETER,
W69-05251 07B

RAFT FOR EVAPORATION-MEASUREMENT EQUIPMENT,
W69-05252 07B

WATER-STAGE AND RAINFALL DUAL RECORDER,
W69-05253 07B

POLAR COORDINATE CHART READER FOR STAGE-RAINFALL RECORDER,
W69-05254 07B

CORRECTING RIVER VELOCITIES MEASURED FROM AN UNANCHORED SHIP,
W69-05255 07B

PATTERNS OF BACKWATER AND DISCHARGE ON SMALL ICE-AFFECTED STREAMS,
W69-05256 07B

VARIABLE-SPEED POWER EQUIPMENT FOR DEPTH-INTEGRATION SEDIMENT SAMPLING,
W69-05257 07B

ELECTRIC CONTROL SYSTEM FOR DUAL OPERATION OF CURRENT METER AND SUSPENDED-SEDIMENT SAMPLER,
W69-05258 07B

CHARACTERISTICS OF LOGARITHMIC RATING CURVES,
W69-05259 07B

INTERPRETATION OF FLOOD-FREQUENCY DATA,
W69-05260 07B

AN OUTLINE OF GEOPHYSICAL LOGGING METHODS AND THEIR USES IN HYDROLOGIC STUDIES,
W69-05261 07B

WATER RESOURCES OF THE SALMON FALLS CREEK BASIN, IDAHO-NEVADA,
W69-05409 02E

HYDROLOGIC EFFECTS OF THE 1962-66 DROUGHT ON LONG ISLAND, N. Y.,
W69-05411 02A

FREQUENCY CURVES FOR ANNUAL FLOOD SERIES WITH SOME ZERO EVENTS OR INCOMPLETE DATA,
W69-05455 07C

GEORGIA UNIV., ATHENS. SCHOOL OF FORESTRY AND NORTHEASTERN FOREST EXPERIMENT STATION, UPPER DARBY, PA.
IN DEFENSE OF EXPERIMENTAL WATERSHEDS,
W69-05405 02A

GIDROMETEOROLOGICHESKII INSTITUT, ODESSA (USSR).
MOUNTAIN RIVER FLOOD RUNOFF THEORY, MEANS OF ITS INVESTIGATION AND CALCULATION,
W69-05230 02A

NUMERICAL FORECASTING OF MOUNTAIN RIVER FLOOD RUNOFF ON THE BASIS OF ESTABLISHING TERRITORIALLY - GENERALIZED RELATIONSHIPS,
W69-05231 02A

GREATER PORTLAND CHAMBER OF COMMERCE, MAINE UNION DESIGN GROUPS, NEWPORT, R. I.
HARBOR DEVELOPMENT PORT OF PORTLAND, MAINE.
W69-05298 06B

GUELPH UNIV. (ONTARIO).
HYDRODYNAMIC DISPERSION IN A SATURATED HOMOGENEOUS POROUS MEDIUM AT LOW PECLET NUMBERS AND NONHOMOGENEOUS SOLUTION,
W69-05434 01B

HAWAII INST. OF GEOPHYSICS, HONOLULU.
EVALUATION OF SOME GEOPHYSICAL TECHNIQUES APPLIED TO THE ENVIRONMENT OF A MAUI WELL,
W69-05418 02F

HYDROLOGICAL RESEARCH UNIT, WALLINGFORD (ENGLAND) GIBB (ALEXANDER) AND PARTNERS, LONDON (ENGLAND).
THE ASSESSMENT OF RUNOFF FROM A MOUNTAINOUS AND SEMI-ARID AREA IN WESTERN IRAN,
W69-05233 02E

HYDROMETEOROLOGICAL CENTRE (USSR).
STUDIES OF RUNOFF FORMATION UNDER CONDITION OF HIGH-ANGLE ATTITUDE OF THE IMPERVIOUS BED,
W69-05229 02E

IDAHO UNIV., MOSCOW. WATER RESOURCES RESEARCH INST.
LIMNOLOGICAL STUDIES OF LENTIC WATERS,
W69-05302 02H

A LETHAL INDEX FOR CLASSIFYING CHEMICALS WHICH AFFECT WATER QUALITY OF AQUATIC LIFE,
W69-05303 05C

STUDIES ON METHODS OF SOIL WATER DETERMINATION,
W69-05304 02G

STUDIES OF METHODS OF SOIL WATER DETERMINATION,
W69-05305 02G

ILLINOIS UNIV., URBANA.
FACTOR ANALYSIS AND REGRESSION,
W69-05517 06B

IMPERIAL COLL. OF SCIENCE AND TECHNOLOGY, LONDON (ENGLAND).
DESIGN CRITERIA FOR LABORATORY CATCHMENT EXPERIMENTS, WITH PARTICULAR REFERENCE TO RAINFALL SIMULATION,
W69-05234 02A

INDIAN AGRICULTURAL RESEARCH INST., NEW DELHI. DIV. OF BOTANY.
MEASUREMENT OF DROUGHT RESISTANCE IN CROP PLANTS,
W69-05265 02G

INSTITUTE FOR LAND AND WATER MANAGEMENT RESEARCH, WAGENINGEN (NETHERLANDS).
A METHOD OF DETERMINING EVAPOTRANSPIRATION IN SOIL MONOLITHS,
W69-05270 02D

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT, WASHINGTON, D. C.
WATER SUPPLY PROBLEMS IN DEVELOPING COUNTRIES,
W69-05513 03D

INTER-AMERICAN CENTER FOR INTEGRAL DEVELOPMENT OF LAND AND WATER RESOURCES.
INTERGRATING HUMAN-SOCIAL RESOURCES INTO THE WATER RESOURCE DEVELOPMENT PROJECT,
W69-05217 06B

IOWA STATE UNIV., AMES.
WATER ALLOCATION SUPPLY AND DEMAND RELATIONSHIPS,
W69-05483 06B

REGIONAL ECONOMIC DEVELOPMENT AND WATER,
W69-05488 06B

IOWA UNIV., IOWA CITY. AGRICULTURAL LAW CENTER.
LEGAL ASPECTS OF THE SMALL WATERSHED PROGRAM IN IOWA,
W69-05339 04D

JOHNS-MANVILLE PRODUCTS CORP., MANVILLE, N. J.
A PILOT PLANT STUDY FOR REMOVAL OF SOLUBLE SILICA FROM ROSWELL, NEW MEXICO WATER. PHASE 1. INITIAL CONSTRUCTION AND OPERATION,
W69-05335 03A

JOINT UNITED STATES-MEXICO INTERNATIONAL ATOMIC ENERGY AGENCY STUDY TEAM.
NUCLEAR POWER AND WATER DESALTING PLANTS FOR SOUTHWEST UNITED STATES AND NORTHWEST MEXICO.
W69-05208 03A

KANSAS STATE UNIV., MANHATTAN WEATHER BUREAU, SILVER SPRING, MD.
RELATIONSHIP OF PALMER DROUGHT VARIABLES TO YIELD OF WINTER WHEAT,
W69-05283 03F

KANSAS STATE UNIV., MANHATTEN.
DISCUSSION OF CONCEPTUAL ISSUES IN THE CONDUCT OF REGIONAL RESEARCH ON THE ECONOMICS OF WATER,
W69-05481 06B

KANSAS UNIV, LAWRENCE AND ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, PA.

A LIMNOLOGICAL RECONNAISSANCE OF AN IMPOUNDMENT RECEIVING HEAVY METALS WITH EMPHASIS OF DIATOMS AND FISH,
W69-05465 02H

KANSAS UNIV., LAWRENCE.
UNSTEADY FLOW PARAMETERS IN HYDRAULIC DESIGN,
W69-05408 08B

WATER QUALITY CHANGES IN CONFINED HOG WASTE TREATMENT,
W69-05417 05D

KENTUCKY UNIV., LEXINGTON AND TEXAS A AND M UNIV., COLLEGE STATION. WATER RESOURCES INST.
PREDICTION OF SEDIMENT PROFILES IN OPEN CHANNEL FLOW BY TURBULENT DIFFUSION THEORY,
W69-05403 02J

MACDONALD (MURDOCH) AND PARTNERS, LONDON (ENGLAND).
THE ASSESSMENT OF SURFACE RUNOFF FROM RAINFALL DATA FOR AN ARID REGION OF WEST PAKISTAN,
W69-05232 02E

MARYLAND UNIV., COLLEGE PARK.
AN EXPERIMENTAL INVESTIGATION OF PARTIAL AREA CONTRIBUTIONS,
W69-05227 02A

METEOROLOGICAL SERVICE OF CANADA, TORONTO (ONTARIO). HYDROMETEOROLOGY SECTION.
HYDROMETEOROLOGICAL STUDIES IN SUPPORT OF THE INTERNATIONAL FIELD YEAR FOR THE GREAT LAKES,
W69-05222 02B

MICHIGAN STATE UNIV., EAST LANSING.
WATER RESOURCE DEVELOPMENT PUBLIC AND PRIVATE INVESTMENT,
W69-05486 06B

MICHIGAN UNIV., ANN ARBOR.
A COMMENT ON OPTIMIZATION METHODS FOR BRANCHING MULTISTAGE WATER RESOURCE SYSTEMS,
W69-05499 06A

MINISTRY OF IRRIGATION AND POWER (INDIA).
ECONOMICS AND FINANCING OF IRRIGATION PROJECTS,
W69-05221 06C

MINISTRY OF PUBLIC WORKS (SOUTH VIETNAM).
WATER SUPPLY IN THE BRACKISH-WATER REGIONS OF SOUTH VIETNAM.
W69-05457 02L

MINISTRY OF PUBLIC WORKS (VENEZUELA). DEPT. OF HYDRAULIC WORKS.
THE ORGANIZATION OF VENEZUELA FOR THE UTILIZATION OF ITS WATER RESOURCES (SPANISH),
W69-05220 06E

MINNESOTA UNIV., ST. PAUL, SCHOOL OF FORESTRY ARIZONA UNIV., TUCSON, DEPT. OF WATERSHED MANAGEMENT.
THE INTERCEPTION-TRANSPIRATION RELATIONSHIP OF WHITE SPRUCE AND WHITE PINE,
W69-05274 02D

MISSOURI UNIV., COLUMBIA HAWAII UNIV., HONOLULU, WATER RESOURCES RESEARCH CENTER AND ARIZONA UNIV., TUCSON. AGRICULTURAL EXTENSION SERVICE.
MEASUREMENT OF SMALL SURFACE DISPLACEMENTS INDUCED BY FLUID FLOW,
W69-05433 02F

MISSOURI UNIV., COLUMBIA.
A LAWYER LOOKS AT WATER RESOURCE ECONOMICS,
W69-05292 06E

MONTANA STATE UNIV., BOZEMAN. DEPT. OF BOTANY AND MICROBIOLOGY.
EFFECT OF IMPOUNDMENTS ON PRODUCTIVITY, WATER CHEMISTRY, AND HEAT BUDGETS OF RIVERS,
W69-05469 02H

NATIONAL WATERWAYS CONFERENCE, INC., WASHINGTON, D. C.
THE ORIGIN AND DEVELOPMENT OF THE WATERWAYS POLICY OF THE UNITED STATES,
W69-05338 04A

NEBRASKA UNIV., LINCOLN WASHINGTON STATE UNIV., PULLMAN.
SOIL MOISTURE CONDITIONS UNDER PASTURES OF COOL-SEASON AND WARM-SEASON GRASSES,
W69-05266 02G

NEVADA UNIV., RENO CORNELL UNIV., ITHACA, N. Y.
EFFECTS OF MOISTURE AND FERTILIZER ON YIELDS OF SPRING WHEAT AND BARLEY,
W69-05263 02I

NEW HAMPSHIRE UNIV., DURHAM NATIONAL MARINE WATER QUALITY LAB., KINGSTON, R. I.
DEMONSTRATION OF A TOXIN FROM APHANIZOMENON FLOS-AQUAE (L.) RALFS,
W69-05306 05C

NEW HAMPSHIRE UNIV., DURHAM.
ECONOMIC ANALYSIS OF PUBLIC WATER SUPPLY IN THE PISCATAQUA RIVER WATERSHED,
W69-05510 03E

NEW SOUTH WALES UNIV. KENSINGTON (AUSTRALIA) AND COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA). DIV. OF LAND RESEARCH.
RECURRENCE INTERVALS BETWEEN EXCEEDANCES OF SELECTED RIVER LEVELS. 2. ALTERNATIVES TO A MARKOV MODEL,
W69-05454 02E

NEW SOUTH WALES UNIV., KENSINGTON (AUSTRALIA).
THE ESTIMATION OF MARGINAL PRODUCT FROM A COBB-DOUGLAS PRODUCTION FUNCTION,
W69-05521 06B

NEW YORK STATE DEPT. OF CONSERVATION, ALBANY. DIV. OF WATER RESOURCES.
A STATE VIEWPOINT ON RIVER BASIN PLANNING,
W69-05209 06B

NORTH CAROLINA UNIV., CHAPEL HILL. INST. OF GOVERNMENT AND NORTH CAROLINA STATE UNIV., RALEIGH. WATER RESOURCES RESEARCH INST.
PROCEEDINGS OF SYMPOSIUM ON BETTER WATER AND SEWER SERVICES FOR SMALL COMMUNITIES IN NORTH CAROLINA,
W69-05424 06B

NORTH CAROLINA UNIV., CHAPEL HILL. WATER RESOURCES RESEARCH INST.
PROCEEDINGS-SYMPOSIUM ON BETTER WATER AND SEWER SERVICES FOR SMALL COMMUNITIES IN NORTH CAROLINA.
W69-05312 03D

NORTH CENTRAL AGRICULTURAL EXPERIMENT STATION, IOWA CITY, IOWA.
REGIONAL AND NATIONAL PLANNING OF AGRICULTURAL RESEARCH,
W69-05482 06B

NORTH DAKOTA UNIV., GRAND FORKS. DEPT. OF BIOLOGY.
RESERVOIR EUTROPHICATION AND DYSTROPHICATION FOLLOWING IMPOUNDMENT,
W69-05471 02H

NOTTINGHAM UNIV. (ENGLAND) AND STANFORD UNIV., PALO ALTO, CALIF.
THE TYPICAL SPECTRAL SHAPE OF AN ECONOMIC VARIABLE,
W69-05522 06D

OFFICE OF SALINE WATER, WASHINGTON, D. C.
BASIC STUDIES OF SCALE CONTROL,
W69-05334 03A

OHIO AGRICULTURAL RESEARCH AND DEVELOPMENT CENTER, WOOSTER.
A PROPOSED MECHANICS FOR THE INVESTIGATION OF SURFACE RUNOFF FROM SMALL WATERSHEDS. 1, DEVELOPMENT,
W69-05425 02A

OHIO STATE UNIV., COLUMBUS.
IDENTIFICATION OF ZOOGLOEA SPECIES AND THE RELATIONSHIP TO ZOOGLOEAL MATRIX AND FLOC FORMATION,
W69-05313 05C

DEVELOPMENT OF BIOLOGICAL INDICES TO POLLUTION LEVELS IN STREAMS AFFECTED BY ACID MINE DRAINAGE AND OIL FIELD BRINE WASTES,
W69-05407 05A

OHIO STATE UNIV., COLUMBUS. WATER RESOURCES CENTER.
THE MICROBIAL FLORA OF ACID MINE WATER AND ITS RELATIONSHIP TO FORMATION AND REMOVAL OF ACID,
W69-05314 05G

OREGON AGRICULTURAL EXPERIMENT STATION, CORVALLIS PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION, CORVALLIS, ORE. AND LOUVAIN UNIV. (BELGIUM).
PORE SIZE DISTRIBUTIONS AS MEASURED BY THE MERCURY INTRUSION METHOD AND THEIR USE IN PREDICTING PERMEABILITY,
W69-05439 02G

OREGON STATE UNIV., CORVALLIS.
CONCEPTUAL ISSUES IN THE CONDUCT OF REGIONAL RESEARCH ON THE ECONOMICS OF WATER,
W69-05480 06B

OREGON STATE UNIV., CORVALLIS. DEPT. OF CIVIL ENGINEERING AND STANFORD UNIV., CALIF. DEPT. OF CIVIL ENGINEERING.
SHOALING OF SOLITARY WAVES ON SMALL SLOPES,
W69-05450 02H

OREGON STATE UNIV., CORVALLIS. FOREST RESEARCH LAB.
PREDICTING TEMPERATURES OF SMALL STREAMS,
W69-05427 02E

OREGON STATE UNIV., CORVALLIS. WATER RESOURCES RESEARCH INST.
WATER LAW, POLITICS, AND ECONOMICS OUR COMPLEX WATER LAWS AND WATER USE CUSTOMS,
W69-05296 06E

WATER LAW, POLITICS, AND ECONOMICS FEDERAL CONTROL OF WATER RESOURCES,
W69-05297 06E

PEAT, MARWICK, MITCHELL AND CO., SAN DIEGO, CALIF.
THE ACCOUNTANT'S VIEWPOINT ON WATER PRICING POLICY,
W69-05494 06C

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK COLORADO UNIV., BOULDER.
GRANITES, GRUSSES, AND THE SHERMAN EROSION SURFACE, SOUTHERN LARAMIE RANGE, COLORADO-WYOMING,
W69-05211 02J

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK.
EFFECT OF MOISTURE REGIMES AND HARVESTS ON EFFICIENCY OF WATER USE BY TEN FORAGE CROPS,
W69-05268 02I

DISCUSSION OF REGIONAL ECONOMIC DEVELOPMENT AND WATER,
W69-05489 06B

A DISCUSSION OF DATA SYSTEMS AND INFORMATION RETRIEVAL ADAPTABLE TO WATER RESOURCES,
W69-05491 06B

PRINCETON UNIV., N. J.
A NOTE ON THE DUAL PRICES OF INTEGER PROGRAMS,
W69-05523 06C

PRINCETON UNIV., N. J. LEWIS F. MOODY HYDRODYNAMICS LAB., AND PRINCETON UNIV., N. J. DEPT. OF CIVIL AND GEOLOGICAL ENGINEERING.
ARTIFICIAL MIXING OF DENSITY-STRATIFIED FLUIDS A LABORATORY INVESTIGATION,
W69-05412 02H

PULP MANUFACTURERS RESEARCH LEAGUE, INC., APPLETON, WIS.
COMPONENTS OF WOOD PULP BLEACH EFFLUENTS,
W69-05402 05A

PUNJAB AGRICULTURAL UNIV., HISSAR (INDIA). COLL. OF AGRICULTURE.
STUDIES ON WATER USE IN PEA (PISUM SATIVUM L.),
W69-05287 03F

PURDUE UNIV., LAFAYETTE, IND.
STATISTICAL ANALYSIS OF GROUND WATER USE AND REPLENISHMENT,
W69-05475 02F

QUEENSLAND UNIV., BRISBANE (AUSTRALIA). DEPT. OF BOTANY.
TISSUE WATER RELATIONS FOR BRIGALOW AND MULGA,
W69-05281 02I

QUEEN'S UNIV., KINGSTON (ONTARIO).
LONG SWINGS,
W69-05498 06B

READING UNIV. (ENGLAND). DEPT. OF GEOPHYSICS.
ON THE REPRESENTATION OF THE REYNOLDS STRESS IN A TIDAL ESTUARY,
W69-05213 02L

RESEARCH COUNCIL OF ALBERTA, EDMONTON.
FLUID FLOW IN THE WESTERN CANADA SEDIMENTARY BASIN - 1. EFFECT OF TOPOGRAPHY,
W69-05451 02F

RESEARCH FOR THE FUTURE, INC., WASHINGTON, D. C.
MAJOR RESEARCH PROBLEMS IN WATER QUALITY,
W69-05519 05G

RHODE ISLAND UNIV., KINGSTON. WATER RESOURCES CENTER.
A STUDY OF THE EFFECT OF TAXATION ON THE SIX PRIVATE OR QUASI-MUNICIPAL WATER UTILITIES IN RHODE ISLAND,
W69-05316 06C

ROBERT A. TAFT SANITARY ENGINEERING CENTER, CINCINNATI, OHIO. CINCINNATI WATER RESEARCH LAB.
WATER QUALITY IN IMPOUNDMENTS AND MODIFICATIONS FROM DESTRATIFICATION,
W69-05467 02H

SCRIPPS INSTITUTION OF OCEANOGRAPHY, SAN DIEGO, CALIF. INST. OF MARINE RESOURCES.
EFFECTS OF PHOSPHATE CONCENTRATION ON CELL DIVISION RATES AND YIELD OF A TROPICAL OCEANIC DIATOM,
W69-05530 05C

SOCIETY OF HYDROGEOLOGICAL SCIENTISTS GRAZ, (AUSTRIA).
SALT WATER ENCROACHMENT IN KARST AQUIFERS, ISLAND OF KEPHALLINIA, (IONIAN),
W69-05472 02L

SOIL CONSERVATION SERVICE, MCCOOK, NEBR.
FLAT CHANNEL TERRACES,
W69-05282 02J

SOIL CONSERVATION SERVICE, WASHINGTON, D. C.
EAST FORK DUCK CREEK WATERSHED NOBLE AND WASHINGTON COUNTIES, OHIO.
W69-05329 06B

SOUTH DAKOTA STATE UNIV., BROOKINGS AND WISCONSIN UNIV., MADISON.
REGIONAL RESEARCH IN WATER IN THE NORTH CENTRAL REGION,
W69-05478 06B

SOUTH DAKOTA STATE UNIV., BROOKINGS.
DISCUSSION OF WATER ALLOCATION SUPPLY AND DEMAND RELATIONSHIPS,
W69-05485 06B

SOUTHERN ILLINOIS UNIV., CARBONDALE. DEPT. OF BOTANY.
RESERVOIR MANAGEMENT PROBLEMS CREATED BY INCREASED PHOSPHORUS LEVELS OF SURFACE WATERS,
W69-05470 02H

STANFORD UNIV., PALO ALTO, CALIF.
USE OF THE DURBIN-WATSON STATISTIC IN INAPPROPRIATE SITUATIONS,
W69-05516 06D

STATE HYDROLOGICAL INST., LENINGRAD (USSR).
PROBLEMS OF THE METHODS AND ACCURACY OF HYDROLOGIC OBSERVATIONS (RUSSIAN),
W69-05210 07A

EVAPORATION FROM BOGS IN THE EUROPEAN TERRITORY OF THE USSR,
W69-05214 02D

SUEZ CANAL AUTHORITY RESEARCH CENTER, ISMAILIA (EGYPT).
WATER WAVES OVER A RECTANGULAR CHANNEL THROUGH A REEF,
W69-05448 02L

TECHNICAL UNIV. OF BUDAPEST (HUNGARY).
INCREASING OR DECREASING RETURNS TO SCALE IN THE CONSTANT ELASTICITY OF SUBSTITUTION PRODUCTION FUNCTION,
W69-05505 06D

TEL AVIV UNIV. (ISRAEL).
CAPITAL FORMATION AND GOVERNMENT CAPITAL POLICY IN DEVELOPING ECONOMIES,
W69-05518 06C

TENNESSEE UNIV., KNOXVILLE. DEPT. OF SANITARY ENGINEERING.
WATER QUALITY INVESTIGATION, PART 1 - BASIC DATA, FORT LOUDOUN RESERVOIR, APRIL 1966 - JUNE 1968,
W69-05416 05A

TENNESSEE VALLEY AUTHORITY, KNOXVILLE.
USING ANALYTICAL METHODS TO DEVELOP A SURFACE-RUNOFF MODEL,
W69-05431 02A

TENNESSEE VALLEY AUTHORITY, KNOXVILLE. DIV. OF NAVIGATION DEVELOPMENT.
BROAD SCOPE OF NAVIGATION'S ECONOMIC IMPACT,
W69-05449 06B

TENNESSEE VALLEY AUTHORITY, NORRIS. ENGINEERING LAB.
THE MECHANICS OF STRATIFIED FLOW IN RESERVOIRS,
W69-05464 02H

TEXAS A AND M UNIV., COLLEGE STATION AND TEXAS UNIV., AUSTIN.
OPTIMIZATION METHODS FOR BRANCHING MULTISTAGE WATER RESOURCE SYSTEMS--A REPLY TO A COMMENT BY E. F. BRATER,
W69-05501 06A

TEXAS A AND M UNIV., COLLEGE STATION. DEPT. OF PLANT SCIENCES.
PESTICIDE LEVELS AND FLUCTUATION IN SOIL BACTERIA IN AN IRRIGATED FIELD AND A POND OF SOUTHWEST TEXAS,
W69-05272 05C

TEXAS AGRICULTURAL EXPERIMENT STATION, EL PASO.
VARIABLE ROW SPACING OF IRRIGATED COTTON AS A MEANS FOR REDUCING PRODUCTION COSTS AND CONSERVING WATER,
W69-05277 03F

THOMAS J. WATSON RESEARCH CENTER, YORKTOWN HEIGHTS, N. Y.
SYNTHETIC HYDROGRAPHS EFFECTS OF NETWORK GEOMETRY,
W69-05432 02A

COMPUTER EXPERIMENTS WITH FRACTIONAL GAUSSIAN NOISES, PARTS 1, 2, AND 3,
W69-05453 07C

THOMAS J. WATSON RESEARCH CENTER, YORKTOWN HEIGHTS, N. Y. AND OHIO STATE UNIV., COLUMBUS.
AN ALTERNATIVE PROOF OF HANNAN'S THEOREM ON CANONICAL CORRELATION AND MULTIPLE EQUATION SYSTEMS,
W69-05511 06D

U S GEOLOGICAL SURVEY, WASHINGTON, D. C.
CONSTANT-RATE-INJECTION EQUIPMENT FOR DYE-DILUTION DISCHARGE MEASUREMENTS,
W69-05237 07B

UNIVERSITY OF SOUTHERN CALIFORNIA, LOS ANGELES.
STATEMENT,
W69-05497 06C

UTAH STATE UNIV., LOGAN. DEPT. OF PLANT SCIENCE.
EFFECT OF EARLY-SUMMER SEEDING OF WINTER WHEAT ON YIELD, SOIL MOISTURE, AND SOIL NITRATE,
W69-05280 03F

UTAH UNIV., SALT LAKE CITY.
THE ECONOMICS OF WATER ALLOCATION IN UTAH,
W69-05507 06D

VOLCANI INST. OF AGRICULTURAL RESEARCH, BET DAGAN (ISRAEL) AND ISRAEL METEOROLOGICAL SERVICE, BET DAGAN.
AN ACCURATE SMALL ORIFICE RAIN GAGE,
W69-05404 07B

WARWICK UNIV., COVENTRY (ENGLAND).
WELFARE ECONOMICS, ECONOMIC GROWTH AND THE CHOICE OF TECHNIQUES,
W69-05500 06B

WASHINGTON UNIV., SEATTLE WASHINGTON STATE UNIV., PULLMAN.
FOURTH ANNUAL REPORT OF THE STATE OF WASHINGTON WATER RESEARCH CENTER, 1968.
W69-05322 09D

WEATHER BUREAU, SILVER SPRING, MD.
THE WEATHER BUREAU AND WATER MANAGEMENT.
W69-05336 07C

WHITE RIVER BASIN COORDINATING COMMITTEE.
COMPREHENSIVE BASIN STUDY ON WHITE RIVER BASIN, ARKANSAS AND MISSOURI.
W69-05201 06B

WISCONSIN UNIV., MADISON.
AN INCOME-NET WORTH APPROACH TO MEASURING ECONOMIC WELFARE,
W69-05290 06B

NITROGEN CYCLE IN SURFACE AND SUBSURFACE WATERS,
W69-05323 05B

DISCUSSION OF WATER RESOURCE DEVELOPMENT PUBLIC AND

PRIVATE INVESTMENT,
W69-05487 06B

WISCONSIN UNIV., MADISON. DEPT. OF SOILS AGRICULTURAL RESEARCH SERVICE, WASHINGTON, D. C.
DETERMINATION OF ORGANOCHLORINE INSECTICIDES IN SOILS AND WATERS,
W69-05325 05A

WISCONSIN UNIV., MADISON. LAB. OF LIMNOLOGY,
BIOLOGICAL ASPECTS OF EUTROPHICATION IN LAKES MENDOTA, CRYSTAL, TROUT AND GREEN,
W69-05324 02H

WORLD HEALTH ORGANIZATION, GENEVA (SWITZERLAND).
WATER FOR LIVING,
W69-05219 05C

WORLD METEOROLOGICAL ORGANIZATION, GENEVA (SWITZERLAND).
PREPARATION OF CO-ORDINATED PRECIPITATION, RUNOFF AND EVAPORATION MAPS,
W69-05337 02A

WYOMING UNIV., LARAMIE. WATER RESOURCES RESEARCH INST.
COMPUTERIZED SYSTEM FOR WYOMING SURFACE WATER RECORDS,
W69-05326 02E

ACCESSION NUMBER INDEX

06B	W69-05201	03F	W69-05277	06E	W69-05365	02G	W69-05443	05G	W69-05524
05B	W69-05202	02I	W69-05278	06E	W69-05366	02J	W69-05444	05G	W69-05525
04A	W69-05203	03F	W69-05279	06E	W69-05367	05B	W69-05445	05G	W69-05526
04A	W69-05204	03F	W69-05280	04A	W69-05368	02I	W69-05446	05G	W69-05527
04A	W69-05205	02I	W69-05281	04A	W69-05369	02L	W69-05447	05G	W69-05528
04A	W69-05206	02J	W69-05282	05G	W69-05370	02L	W69-05448	07C	W69-05529
04A	W69-05207	03F	W69-05283	06E	W69-05371	06B	W69-05449	05C	W69-05530
03A	W69-05208	02G	W69-05284	06E	W69-05372	02H	W69-05450	05C	W69-05531
06B	W69-05209	03F	W69-05285	06E	W69-05373	02F	W69-05451	06E	W69-05533
07A	W69-05210	02I	W69-05286	04C	W69-05374	02F	W69-05452	06E	W69-05534
02J	W69-05211	03F	W69-05287	06E	W69-05375	07C	W69-05453	06E	W69-05535
10	W69-05212	06B	W69-05288	05B	W69-05376	02E	W69-05454	06E	W69-05536
02L	W69-05213	06B	W69-05289	04A	W69-05377	07C	W69-05455	02H	W69-05537
02D	W69-05214	06B	W69-05290	04C	W69-05378	05D	W69-05456	06E	W69-05538
05G	W69-05215	06B	W69-05291	04C	W69-05379	02L	W69-05457	03D	W69-05539
06D	W69-05216	06E	W69-05292	06E	W69-05380	02E	W69-05458	06E	W69-05540
06B	W69-05217	06E	W69-05293	04A	W69-05381	02E	W69-05459	06E	W69-05541
05D	W69-05218	03F	W69-05294	04A	W69-05382	02E	W69-05460	06E	W69-05542
05C	W69-05219	06B	W69-05295	06E	W69-05383	02E	W69-05461	06E	W69-05543
06E	W69-05220	06E	W69-05296	04A	W69-05384	02E	W69-05462	04A	W69-05544
06C	W69-05221	06E	W69-05297	05C	W69-05385	02H	W69-05463	06E	W69-05545
02B	W69-05222	06B	W69-05298	05G	W69-05386	02H	W69-05464	04A	W69-05546
04A	W69-05223	06B	W69-05299	05C	W69-05387	02H	W69-05465	04A	W69-05547
02E	W69-05225	02H	W69-05302	06E	W69-05388	02H	W69-05466	06E	W69-05548
02C	W69-05226	05C	W69-05303	05G	W69-05389	02H	W69-05467	04A	W69-05549
02A	W69-05227	02G	W69-05304	04A	W69-05390	02H	W69-05468	04A	W69-05550
07B	W69-05228	02G	W69-05305	04A	W69-05391	02H	W69-05469	04A	W69-05551
02E	W69-05229	05C	W69-05306	04A	W69-05392	02H	W69-05470	04A	W69-05552
02A	W69-05230	03D	W69-05312	04A	W69-05393	02H	W69-05471	05C	W69-05553
02A	W69-05231	05C	W69-05313	04A	W69-05394	02L	W69-05472	04A	W69-05554
02E	W69-05232	05G	W69-05314	04A	W69-05395	02L	W69-05473	04C	W69-05555
02E	W69-05233	06C	W69-05316	04A	W69-05396	02F	W69-05474	04C	W69-05556
02A	W69-05234	09D	W69-05322	04A	W69-05397	02F	W69-05475	04A	W69-05557
07B	W69-05235	05B	W69-05323	06E	W69-05398	06B	W69-05478	06E	W69-05558
07B	W69-05236	02H	W69-05324	06E	W69-05399	06B	W69-05479	05B	W69-05559
07B	W69-05237	05A	W69-05325	04A	W69-05400	06B	W69-05480	04A	W69-05560
07B	W69-05238	02E	W69-05326	02F	W69-05401	06B	W69-05481	05G	W69-05561
07B	W69-05239	05D	W69-05327	05A	W69-05402	06B	W69-05482	04A	W69-05562
02E	W69-05240	05D	W69-05328	02J	W69-05403	06B	W69-05483	04A	W69-05563
07B	W69-05241	06B	W69-05329	07B	W69-05404	06B	W69-05485	06E	W69-05564
07B	W69-05242	03F	W69-05330	02A	W69-05405	06B	W69-05486	06E	W69-05565
07B	W69-05243	02I	W69-05331	02G	W69-05406	06B	W69-05487	06E	W69-05566
07B	W69-05244	02G	W69-05332	05A	W69-05407	06B	W69-05488	04A	W69-05567
07B	W69-05245	04D	W69-05333	08B	W69-05408	06B	W69-05489	06E	W69-05568
07B	W69-05246	03A	W69-05334	02E	W69-05409	06B	W69-05490	06E	W69-05570
07B	W69-05247	03A	W69-05335	03B	W69-05410	06B	W69-05491	06E	W69-05571
07B	W69-05248	07C	W69-05336	02A	W69-05411	06C	W69-05492	04A	W69-05572
07B	W69-05249	02A	W69-05337	02H	W69-05412	06C	W69-05493	06E	W69-05573
07B	W69-05250	04A	W69-05338	02F	W69-05413	06C	W69-05494	06E	W69-05574
07B	W69-05251	04D	W69-05339	02E	W69-05414	06C	W69-05495	05G	W69-05575
07B	W69-05252	06E	W69-05340	02E	W69-05415	06C	W69-05497	06E	W69-05576
07B	W69-05253	06E	W69-05341	05A	W69-05416	06B	W69-05498	06E	W69-05577
07B	W69-05254	04A	W69-05342	05D	W69-05417	06A	W69-05499	04A	W69-05578
07B	W69-05255	04A	W69-05343	02F	W69-05418	06B	W69-05500	06E	W69-05579
07B	W69-05256	04A	W69-05344	08E	W69-05419	06A	W69-05501	06E	W69-05580
07B	W69-05257	04D	W69-05345	02A	W69-05420	06B	W69-05502	06E	W69-05581
07B	W69-05258	06E	W69-05346	05A	W69-05421	05G	W69-05503	06E	W69-05582
07B	W69-05259	06E	W69-05347	05D	W69-05422	06D	W69-05505	06E	W69-05583
07B	W69-05260	06E	W69-05348	02E	W69-05423	06D	W69-05506	06E	W69-05584
07B	W69-05261	06E	W69-05349	06B	W69-05424	06D	W69-05507	06E	W69-05585
05G	W69-05262	06E	W69-05350	02A	W69-05425	06B	W69-05508	05G	W69-05586
02I	W69-05263	06E	W69-05351	02A	W69-05426	06B	W69-05509	06E	W69-05587
02I	W69-05264	06E	W69-05352	02E	W69-05427	03E	W69-05510	04A	W69-05588
02G	W69-05265	06E	W69-05353	02L	W69-05428	06D	W69-05511	06E	W69-05589
02G	W69-05266	06E	W69-05354	02A	W69-05431	03D	W69-05513	06E	W69-05590
02G	W69-05267	06E	W69-05355	02A	W69-05432	06B	W69-05514	06E	W69-05591
02I	W69-05268	06E	W69-05356	02F	W69-05433	06B	W69-05515	06E	W69-05592
02G	W69-05269	06E	W69-05357	01B	W69-05434	06D	W69-05516	04A	W69-05593
02D	W69-05270	06E	W69-05358	07C	W69-05435	06B	W69-05517	04A	W69-05594
02F	W69-05271	06E	W69-05359	02F	W69-05436	06C	W69-05518	06E	W69-05595
05C	W69-05272	06E	W69-05360	02A	W69-05438	05G	W69-05519	06E	W69-05596
03C	W69-05273	04A	W69-05361	02G	W69-05439	06B	W69-05520	06E	W69-05597
02D	W69-05274	04A	W69-05362	02G	W69-05440	06B	W69-05521	06E	W69-05598
04A	W69-05275	04A	W69-05363	02G	W69-05441	06D	W69-05522	06E	W69-05599
03C	W69-05276	04A	W69-05364	02G	W69-05442	06C	W69-05523	04A	W69-05600

ABSTRACT SOURCES

A. Centers of Competence:	Accession Numbers	Total
(1) U.S. Geological Survey - Hydrology	W69-05201 -- W69-05262 W69-05401 -- W69-05475	133
(2) University of Arizona - Arid Lands Water Resources	W69-05263 -- W69-05287	25
(3) Rutgers University - Water Resources Economics	W69-05288 -- W69-05294 W69-05478 -- W69-05528	54
(4) University of Chicago - Metropolitan Water Resource Management	W69-05295 -- W69-05299	5
(5) University of Florida - Eastern U.S. Water Law	W69-05338 -- W69-05400 W69-05533 -- W69-05600	130
(6) University of Wisconsin - Eutrophication	W69-05529 -- W69-05531	3
B. Other:		
(1) Georgia Inst of Tech - Water Resources Center		0
(2) University of Idaho - Water Resources Research Institute	W69-05302 -- W69-05305	4
(3) University of New Hampshire - Water Resources Research Center	W69-05306	1
(4) University of North Carolina - Water Resources Research Institute	W69-05312	1
(5) Ohio State University - Water Resources Center	W69-05313 -- W69-05314	2
(6) University of Rhode Island - Water Resources Center	W69-05316	1
(7) Washington State University - Water Research Center	W69-05322	1
(8) University of Wisconsin - Water Resources Center	W69-05323 -- W69-05325	3
(9) University of Wyoming - Water Resources Research Institute	W69-05326	1
(10) Agricultural Research Service	W69-05327 -- W69-05328 W69-05330	3
(11) Soil Conservation Service	W69-05329	1
(12) National Agricultural Library	W69-05330 -- W69-05333	4
(13) Office of Saline Water	W69-05334 -- W69-05335	2
(14) Environmental Science Service Administration	W69-05336	1
	Grand Total	375

Subject Fields

1 NATURE OF WATER

2 WATER CYCLE

3 WATER SUPPLY AUGMENTATION AND CONSERVATION

4 WATER QUANTITY MANAGEMENT AND CONTROL

5 WATER QUALITY MANAGEMENT AND PROTECTION

6 WATER RESOURCES PLANNING

7 RESOURCES DATA

8 ENGINEERING WORKS

9 MANPOWER, GRANTS, AND FACILITIES

0 SCIENTIFIC AND TECHNICAL INFORMATION

INDEXES

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

ABSTRACT SOURCES

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF COMMERCE

LIBRARY RATE
PRINTED MATTER

U.S. DEPARTMENT OF COMMERCE
CLEARINGHOUSE FOR FEDERAL
SCIENTIFIC AND TECHNICAL INFORMATION
SPRINGFIELD, VA. 22151

OFFICIAL BUSINESS